Description of seakeeping experiments carried out on CCGA Atlantic Swell Model IOT651

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DESCRIPTION OF SEAKEEPING EXPERIMENTS CARRIED OUT ON CCGA ATLANTIC SWELL MODEL IOT651

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SUMMARY

This report describes a set of irregular wave seakeeping experiments carried out as part of the Fishing Vessel Safety Project on a 1:4.697 scale model of the 35 ft. (10.67 m) long inshore fishing vessel CCGA Atlantic Swell, designated IOT651, in the Institute for Ocean Technology (IOT) Offshore Engineering Basin (OEB) January – February 2005. The data from these tests was used to correlate with the full scale data acquired during sea trials carried out off St. John's, NL October 4, 2003. The objective of the experiments was to acquire quality model scale seakeeping data to validate numerical prediction software under development at Memorial University of Newfoundland (MUN) and correlate with the full scale data.

This document describes the model fabrication, instrumentation, data analysis procedure, provides the results of the ship /physical model/ numerical model correlation exercise and recommendations to improve the overall correlation in future.

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LIST OF ABBREVIATIONS

B	beam, breadth
CCG	Canadian Coast Guard
CCGA	Canadian Coast Guard Auxiliary
CCGS	Canadian Coast Guard Ship
CG	center of gravity
cm	centimetre(s)
COG	Course Over Ground
deg.	degree(s)
DGPS	Differential Global Positioning System
DOF	Degrees Of Freedom
DV	digital video
ft.	feet, foot
FS	full scale
g	acceleration due to gravity
GDAC	General Data Acquisition and Control
GEDAP	General Data Analysis Package
GM_T	transverse metacentric height
GPS	Global Positioning System
h	height
H_{m0}, H_S	significant wave height
Hz	Hertz
IOT	Institute for Ocean Technology

LIST OF ABBREVIATIONS (cont'd)

kg	kilogram(s)
L	length
LCB	longitudinal centre of buoyancy
LCF	longitudinal centre of floatation
LCG	longitudinal centre of gravity
m	metre(s)
MII	Motion Induced Interruptions
mm	millimetre(s)
MP	MotionPak
MS	model scale
MUN	Memorial University of Newfoundland
NRC	National Research Council
OEB	Offshore Engineering Basin
OMAE	Offshore Mechanics and Arctic Engineering
QA	Quality Assurance
RMS	Root Mean Square
RPM	Revolutions Per Minute
rps	revolutions per second
s, sec.	second(s)
SAR	Search And Rescue
S(f)	energy spectrum (function of frequency)
SNAME	Society of Naval Architects and Marine Engineers

LIST OF ABBREVIATIONS (cont'd)

SOG	Speed Over Ground
Std. Dev.	standard deviation
Sig.	significant value
t	tonne(s), time
T	draft
T1	start time
T2	end time
T_{pd}	period of spectral peak
T_Z	zero crossing period
WL	waterline

DESCRIPTION OF SEAKEEPING EXPERIMENTS CARRIED OUT ON CCGA ATLANTIC SWELL MODEL IOT651

1.0 INTRODUCTION

This report describes a set of irregular wave seakeeping experiments carried out as part of the Fishing Vessel Safety Project on a 1:4.697 scale model of the 35 ft. (10.67 m) long inshore fishing vessel CCGA Atlantic Swell, designated IOT651, in the Institute for Ocean Technology (IOT) Offshore Engineering Basin (OEB) January – February 2005. The data from these tests was used to correlate with the full scale data acquired during sea trials carried out off St. John's, NL October 4, 2003 - described in Reference 1. The objective of the experiments was to acquire quality model scale seakeeping data to validate numerical prediction software under development at Memorial University of Newfoundland (MUN) and correlate with the full scale data.

This document describes the model fabrication, instrumentation, data analysis procedure, provides the results of the ship /physical model/ numerical model correlation exercise and recommendations to improve the overall correlation in future.

2.0 BACKGROUND

The Fishing Vessel Safety Project is just a small component of the overall SafetyNet initiative to understand and mitigate the health and safety risks associated with employment in a marine environment. SafetyNet is the first federally funded research program investigating occupational health and safety in historically high risk Atlantic Canada marine, coastal and offshore industries. The Fishing Vessel Safety Project is conducting research on the occupational health and safety of seafood harvesters. Fishing is the most dangerous occupation in Newfoundland and Labrador and is increasingly so: over the past ten years, the rates of reported injuries and fatalities nearly doubled. These trends have the effect of reducing the sustainability of the fishery, increasing health care and compensation costs, and straining the available SAR resources. The development of effective solutions, to prevent or mitigate injury, fatality or SAR events, has been seriously hindered by the scarcity of the research needed to understand the factors that influence seafood harvester occupational health and safety.

The Fishing Vessel Safety Project is a multi-disciplinary, inter-departmental and inter-sectorial research project. The broad-based and multi-factorial approach in investigating the inter-related factors that influence fishing safety including: fishery policy and vessel regulations, vessel safety design and modeling, human relationships on vessels and health and safety program development, implementation and evaluation. The Fishing Vessel Safety Project is composed of six integrated components:

1) Longitudinal Analysis: A statistical analysis of all fishing injuries, fatalities and SAR incidents from 1989 to 2000 to determine trends and influencing factors of seafood harvester occupational health and safety;
2) Perceptions of Risk: An interview-based study, conducted with seafood harvesters, on the perceptions of causes of accidents and near-misses - and the effectiveness of existing accident prevention programs;
3) Motion Induced Interruptions: Sea trials, physical and numerical modeling of the effects of MIIs, sudden vessel motions induced by wave action, on crew accidents and development of criteria to reduce MIIs;
4) Delayed Return to Work: an interview-based study on the psychological and social factors that delay previously injured seafood harvesters from returning to work;
5) Education Program: The development of an interactive, community-based occupational safety education program for seafood harvesters; and
6) Comparative Analysis: A comparative analysis of accident and fatality rates, and regulatory regimes for fisheries management and fishing vessel safety in Canada, the United States, Iceland, Norway, Denmark, France and Australia.

Several of the project components will yield results that can be directly used by stakeholder organizations for designing and implementing injury and fatality prevention programs. The applied nature of the overall project will be represented by a series of recommendations that will provide accessible and applicable information needed to make informed decisions. Additional information on SafetyNet may be found by visiting their web site (Reference 2).

The effort described in this report is part of Component #3 of the overall Fishing Vessel Research Project. Seakeeping trials on a total of five Newfoundland based fishing vessels ranging in lengths from 35 ft. to 75 ft. (10.67 m to 22.86 m) were completed in 2004 (References 1, 3 to 6). Data was acquired on some of the vessels with and without roll damping devices deployed. Standard seakeeping parameters such as ship motions, speed, and heading angle were recorded along with data on the ambient environmental conditions (wave height/direction, wind speed/direction). Physical models on the 35 ft. ‘Atlantic Swell’ as well as two other vessels (tentatively the two 65 ft. vessels) suitable for free-running operation in the IOT Offshore Engineering Basin (OEB) will be fabricated and tested by IOT over three years in environmental conditions emulating the full scale conditions. Project participants at the MUN Faculty of Engineering will derive numerical models of all five hull forms and run simulations using their non-linear time domain ship motion prediction codes. Validated simulation tools will then be used to predict the expected level of MIIs for different fishing vessel designs.

Additional information on human factors in ship design is provided in References 7 to 10.

3.0 DESCRIPTION OF THE IOT OFFSHORE ENGINEERING BASIN

The IOT Offshore Engineering Basin (OEB) has a working area of 26 m by 65.8 m with a depth that can be varied from 0.1 m to 2.8 m. Waves are generated using 168 individually computer controlled, hydraulically activated, wet back wavemaker segments fitted around the perimeter of the tank in an 'L' configuration. Each segment can be operated in one of three modes of articulation: flapper mode (± 15º), piston mode (± 400 mm), or a combination of both modes. The wavemakers are capable of generating both regular and irregular waves up to 0.5 m significant wave height. Passive wave absorbers are fitted around the other two sides of the tank. The facility has a recirculating water system based current generation capability with current speed dependent on water depth. The facility also has extensive video coverage and is serviced over its entire working area by a 5 tonne lift capacity crane.

4.0 DESCRIPTION OF PHYSICAL MODEL IOT651

A 1:4.697 scale model, designated IOT651, of the CCGA Atlantic Swell was fabricated from wood and glass conforming to surfaces derived by St. John's based Marine Services International Ltd. after manually measuring the full scale hull offsets by hand. The model was constructed using IOT's standard model construction procedure described in Reference 11. Measurements were made at several key locations to verify dimensional accuracy and the model was determined to be within the specified allowable IOT tolerances of ± 0.05% on waterline length and beam and < 2 mm on section shape. The model QA measurements are presented in Table 1.

Model IOT651 included six reference blocks fitted to the gunwales and bow, and milled flat to a known elevation relative to the baseline. The model was fully appended with a set of rolling chocks, a single 0.5 inch (1.27 cm) diameter propeller shaft, a flat plate rudder, and a centerline skeg. A stock four bladed, right-handed turning fixed pitch propeller (#P104R) was used to propel the model. QA information on propeller #P104R is presented in Table 2. No turbulence stimulators were fitted to the hull or appendages. RENSHAPE reinforcement was bonded to the hull port and starboard forward, well above the waterline, to accommodate ¾ inch diameter, 8 inch long (1.905 cm * 20.32 cm) aluminum pins. These pins were designed to interface with the static weight launch system used to accelerate the model to the desired forward speed in an effort to maximize the available run length in the OEB. An eyebolt was fitted just above the waterline on the transverse centerline at the stern, secured to the main deck using an aluminum cantilever, to accommodate a tag line used to arrest the model at the end of each run. Body plan, profile and plan view drawings are provided in Figure 1. Photographs of the model and propeller are provided in Figures 2 to 4.

The model hull was painted yellow and marked with standard station and waterline markings as described in the model construction standard (Reference 11). It was not anticipated that this model would be tested in a high sea state and this fact was taken into consideration in the model watertight integrity strategy. A large lexan hatch was placed over the main deck and rudder servo - secured with four Destaco quick release hold down clamps to protect the internal electronics in the event that water were to reach this height. A simple superstructure simulating the wheelhouse, open at the top, was included forward.

An Aerotech model 1410 motor directly connected to the propeller through a watertight stern tube propelled the model. The maximum continuous rating of the motor is 18 rps, however this speed could be increased to ~22 rps for brief periods.

Other outfit components included rudder servo, motor controller, radio control/telemetry electronics, instrumentation, and several batteries of different size and type. Smaller than usual batteries were procured specifically for this lightweight model in order to minimize weight. The batteries were recharged after ~3.5 hours of operation. The 'Atlantic Swell' was not fitted with an autopilot and thus all steering during the sea trials was manual. In an effort to emulate the full scale situation, the physical model was manually controlled via a radio link by an operator located at one end of the tank. A photograph of the fully outfit model is given in Figure 5. Photographs of the internal outfit layout are provided in Figure 6.

As model IOT651 was relatively small, the weight of the hull and outfit proved to be enough to displace the model to the desired draft and trim. The batteries and instrumentation were arranged in order to both ballast the model to its target displacement and ensure the desired roll/pitch radii of gyration. The model was swung in air to determine its roll and pitch radius of gyration. The swing results are presented in Appendix A. An inclining experiment was carried out on the fully outfit model in the IOT Tow Tank trim dock. The nominal roll period was checked at this time as well. The disposition of the weight in the model was altered to achieve a compromise between attaining the desired transverse metacentric height and roll period. The results of the inclining experiment and roll period checks are also included in Appendix A.

An existing cradle was modified to accommodate the model during transit as well as launch/recovery of the model in the OEB. Two slings attached to a 1.5 t capacity strong back lifted using the main 5 t capacity OEB overhead crane supported the model during launch and recovery.

Model IOT651 was tested for one displacement condition during the seakeeping trials. This condition corresponded to the nominal condition recorded during the October 2003 seakeeping trial off St. John's as described in Reference 1. The hydrostatics for the full-scale ship and physical model in this displacement condition are presented in Appendix B.

5.0 DESCRIPTION OF NUMERICAL PREDICTION PROGRAM 'MOTSIM'

To address some of the deficiencies inherent in standard two dimensional strip theory ship motion prediction programs, researchers from MUN and IOT developed a non-linear time domain code called MOTSIM that simulates six degrees of freedom motion (described in Reference 12). The geometry is defined in terms of a series of sections each described by a set of panels – the more panels, the longer the computation time. At each time step, the code determines the intersection of these panels with the waterline and redefines the paneling describing the ship's waterline. The pressure forces associated with the incident waves are then numerically integrated over the surface, using second order Gaussian Quadrature. The waves are taken as second order Stokes waves. The normal velocity distribution associated with the velocity of the vessel and the incident wave particle velocities is averaged over each panel. A least square fitting of this distribution based on the wetted panels belonging to a particular section is then made such that a unique decomposition of the modal velocities (surge, sway, heave and roll) is obtained that most closely satisfies the body boundary condition on the section. The use of wetted surface to determine modal velocities serves as an approximation to a non-linear body boundary condition. The code permits more general decompositions of the velocity distribution to be made using a higher number of standard or non-standard modes. From this decomposition, the scattering forces and moments are determined for each section based on pre-calculated memory functions. The memory functions for each section are derived using added mass and damping coefficients from zero speed linear theory over a truncated semi-infinite frequency range. Their use allows for arbitrary frequency content in the scattering forces and moments. The added mass and damping coefficients can be either two or three dimensional. Corrections are made for forward speed. Viscous effects associated with roll damping and manoeuvring are determined using semi-empirical formulae or experimentally determined coefficients. The total forces are then used in the non-linear equations of motions to determine the motions of the vessel.

The principle characteristics of this computational intensive software are:

- non-linear Froude-Krylov forces based on the calculated wetted surface of the hull at each time step; and
- radiation and diffraction forces are determined as a single set of scattering forces (based on relative motions) and obtained from memory functions, which are evaluated based on linear theory using a three dimensional panel code.

Thus MOTSIM is considered to be based on a hybrid theory with nonlinear Froude-Krylov terms, but with quasi non-linear three dimensional hydrodynamic terms. Higher amplitude waves can be accommodated and since three dimensional coefficients are calculated, the motions of lower L/B ratio hull forms can be computed with complex end effects included. Over the last several years, MOTSIM has been validated against a number of full scale and model scale data sets, and improvements such as a manoeuvring prediction capability as well as a capability to output Motion Induced Interruptions (MIIs) have been added. The sea trials on the 'Atlantic Swell' provided an invaluable opportunity to evaluate the algorithm using a small vessel in a complex multi-directional seaway. Preliminary validation of MOTSIM for predicting full scale motions is provided in Reference 13.

6.0 DESCRIPTION OF THE INSTRUMENTATION

This section describes the instrumentation and calibration methodology used for each parameter measured:

Model Motions

Model motions were measured using the following two independent systems:

1) Systron Donner MotionPak I: Model motions with six degrees of freedom were measured using this unit fitted at the model's nominal center of gravity. The sensor unit consists of three orthogonal linear accelerometers measuring heave, sway and surge acceleration (g's) and three orthogonal angular rate sensors measuring roll, pitch and yaw rates (degrees/second).

   The three angular rate sensors were calibrated using manufacturer's data sheets while the three accelerometers were physically calibrated by placing the sensor package on a set of precision wedges machined to defined angles and computing the acceleration relative to the acceleration due to gravity. The sway and surge accelerometers output zero g's while the heave accelerometer outputs –1.0 g when the model is level and stationary. The intermediate accelerations were computed as follows:

   Acceleration = 1.0 * sin (angle of inclination)

2) QUALISYS System: Several infrared emitters were fitted on lightweight Plexiglas masts of varying lengths permitting the model to be tracked using an array of 6 cameras located at the east end of the OEB. The system was used to measure the following six motions: orthogonal linear displacements (X, Y, Z) translated to the model CG in a tank co-ordinate system; heading angle relative to a tank co-ordinate system; pitch and roll angle in a body co-ordinate system. Planar (X, Y) position from the QUALISYS system was used to determine model speed over ground. Calibration of the QUALISYS system is carried out when the system is surveyed in using survey points located around the tank.

Bow Accelerometers

Mounted solely as a verification for MotionPak analysis algorithm. The vertical and lateral accelerometers were calibrated the same way as the MotionPak accelerometers and were fitted 150 mm to port, 520 mm forward and 117.5 mm above the MotionPak.

Rudder Angle

Rudder Angle was measured by fitting a rotational potentiometer on the pivot point of the rudder. This parameter was calibrated relative to a protractor fitted adjacent to the linkage. No effort was made to duplicate the ship's rudder slew rate model scale.

Shaft Rotation

The shaft rotation was measured using a tachometer integral with the propulsion motor. The tachometer provided an analog signal linearly proportional to shaft speed and was calibrated using a laser tachometer aimed at a piece of reflective tape on the shaft.

Wave Elevation

Wave elevation was measured using four freestanding capacitance wave probes – three situated on the south side of the tank while a fourth was fitted on the north side. The waves were matched using a separate wave probe fitted during the wave matching process only at a position defined as test center (0,0) - a central point in the OEB. The nominal locations of the wave measurement probes relative to test center were:

South West probe: X = 14.4 m west of test center, Y = 8 m south of test center
South Center probe: X = 0 m (test center), Y = 8 m south of test center
South East probe: X = 14.4 m east of test center, Y = 8 m south of test center
North Center probe: X = 0 m (test center), Y = 8 m north of test center

It was never necessary to move a wave probe from the surveyed position to avoid having an obstruction in the model path. All wave probes were calibrated using the OEB wave probe calibration facility. A sketch of the OEB layout for these experiments is provided in Figure 7.

Data Acquisition

All analog data was low pass filtered at 10 Hz, amplified as required, and digitized at 50 Hz. All data acquired from model sources was conditioned on the model prior to transfer to the shore based data acquisition computer via radio telemetry. The wave elevation and QUALISYS data were conditioned/digitized using a NEFF signal conditioner, transferred to the data acquisition system via cable and stored in parallel with the telemetry data. Synchronization between the NEFF data and telemetry data is nominally within 0.2 s.

In addition, an RMS error channel was acquired to monitor QUALISYS signal integrity and the amplitude of one south and one west wave board segment was acquired to monitor wave board activity. A list of signals measured is provided in Table 3 while the calibration sheets for each channel are given in Appendix C. All signals were calibrated using the standard IOT sign convention described in Reference 14.

7.0 DESCRIPTION OF THE EXPERIMENTAL SET-UP

The OEB was configured as follows for these experiments:

Water Depth: The water depth was set at 2.8 m for the seakeeping experiments – thus the model was assumed to be operating in deep water (h/T > 4) so there were no shallow water hydrodynamic effects.

Blanking Walls: Blanking walls that can be used to cover the beaches on the north side were removed for all seakeeping experiments.

Segmented Wave Board Configuration: All boards were set in piston mode with the bottom of the wave makers adjusted to 1.3 m above the floor of the OEB.

Wave Generation: Several multi-directional irregular waves, corresponding to the waves as measured at sea using a moored directional wave buoy during the full scale trials, were matched with dominant wave direction relative to the south wall of the OEB of 25 degrees and 65 degrees. Two wave directions were used to provide some flexibility regarding the model direction. The full scale wave segments were nominally 18 minutes in length full scale.

The waves used for the 'Atlantic Swell' tests were generated using two sets of spreading function characteristics – designated the 'MUN' waves used for all experiments and the 'IOT' waves used for a few of the experiments for comparison. The MUN wave spreading functions were generated using program DSF2 which allows for the entry of individual frequencies, their angle and the energy spectrum (S(f)) values resulting in an asymmetric spreading about the dominant wave direction. These spreading functions are then fed to our normal multidirectional wave generation routines to derive the wave board drive signals. The IOT version of the waves were generated using program DSF5 that creates a uniform spreading function around the mean wave angle. This spreading function was then input into the same routines as the MUN waves to generate the wave board drive signals. Some challenges were experienced matching the MUN defined waves as they were very asymmetric (short wave lengths from one direction, long wave lengths from another) and the total angle envelope was sometimes greater than 180 degrees.

The standard IOT wave matching process for multi-directional spectra is described in Reference 15. A listing of the waves used is provided as follows:

WAVE NUMBER	WAVE DIRECTION (relative to OEB south wall)	MUN, IOT
WAVE 1F	25	MUN
WAVE 1	25	MUN
WAVE 2	25	MUN, IOT
WAVE 2F	65	MUN
WAVE 2	65	MUN, IOT
WAVE 3	25	MUN, IOT
WAVE 3	65	MUN
WAVE 3F	25	MUN

where 'F' represents wave spreading angle characteristics 'flipped' about their dominant axis. The ability to flip these waves provided additional flexibility with respect to model direction since there was a desire to have specified wave characteristics acting on the model port or starboard side. The following full scale waves from the Neptune Sciences, Inc. directional wave buoy used to acquired wave data during the sea trial were emulated in the OEB:

WAVE #1: acquired October 4, 2003 @ 08:00 Newfoundland time
WAVE #2: acquired October 4, 2003 @ 09:30 Newfoundland time
WAVE #3: acquired October 4, 2003 @ 10:00 Newfoundland time

Note: WAVE #3 significant wave height (H_{m0}) was reduced by 20% since the wave buoy failed (the last successful transmission was 10:00 Newfoundland time) and thus the full scale wave data for the remainder of the day is an extrapolated estimate. Measured H_{m0} = 1.38 m. Reduced H_{m0} = 1.245 m

where: $H_{m0} = 4 * (m0)^{1/2}$
$m0 = \Sigma$ [C11(f)*df]
Σ C11 = 11.0108 m^2/Hz
Σ 0.8*C11 = 8.8086 m^2/Hz
df = 0.011 Hz

A description of full scale waves #1 to 3 and the results of the wave matching effort for both the MUN and IOT version of all waves used, including 'flipped' waves, are provided in Appendix D.

<u>Video Cameras:</u>

Four digital video (DV) cameras were deployed to record the experiments:

1) View #1: camera mounted on a bracket and manually directed by an operator on a temporary platform fitted on scaffolding in the tank with the recorder located in the OEB control room. The camera position was 1.5 m north of the south wave boards, 11.1 m east of test center.

2) View #2: camera fixed to a temporary platform fitted on scaffolding in the tank with the recorder located in the OEB control room. The camera was fitted with a wide-angle lens in order to view the model throughout the run. The camera position was 1.5 m north of the south wave boards, 8.84 m west of test center.

3) View #3: camera mounted in a metal frame on the west wall of the OEB, roughly on the OEB longitudinal centerline, 4.68 m off the OEB floor. This camera was directed remotely (pan, tilt, zoom) by an operator in the OEB control room.

4) View #4: fixed camera mounted on OEB north walkway directed to view along the model path and controlled from OEB Control Room.

Note that video View #1 camera was interchanged with video View #2 camera when the model was being launched from the west end of the OEB. Video View #2 was manually directed for this situation.

Videos were recorded on one hour digital video tapes annotated with file name and record time.

Model Launch System

A gravity-based model acceleration system was used to restrain the model in the initial waves prior to launch and accelerate the model from a standing start to maximize the available run length. The model was held in place in a floating cradle that consisted of a ‘U’ shaped aluminum frame accommodating a foam insert conforming to the breadth of the model. Two weights were suspended off the ends of vertical posts at the end of the launch system and attached to the cradle by a rope and pulley system. This system was used to translate the vertical force imparted by the dropping weights into horizontal thrust on two pins bolted port and starboard into RENSHAPE inserts on the model. A lightweight safety line attached from an anchor point on shore to an eyebolt just above the waterline at the model stern was used to arrest the model at the end of the run.

To activate the launch system, two 20 kg weights were first manually winched up to a desired height above the tank bottom. Once the weights were suspended at the correct height, the model safety line was attached to a release mechanism. When the mechanism was activated, the weights dropped to the bottom of the tank, and the cradle was accelerated forward. The amount of acceleration required depended on the model heading with respect to the dominant incident waves. The required position and size of the weights was determined by trial and error. Photographs of the model constrained in the launch frame are provided in Figure 8.

Model Service Dock:

A platform was located adjacent to the north wall roughly 10 m west of test center such that the model could be serviced locally and conveniently launched/ recovered using the OEB overhead crane. This dock was positioned to minimize interference with the view of QUALISYS cameras mounted at the east end of the tank.

Model Control System

The shaft speed and rudder angle were controlled and manipulated by software installed on an on-shore desktop computer that communicated with the model via a wireless modem. The model operator inputs a preset shaft speed, a value that is estimated to propel the model at the desired forward speed in waves. The shaft speed remains constant throughout the run. No autopilot was used for these experiments - a helmsman varying rudder angle using a commercial video game steering wheel mounted on the table adjacent to the shore-based computer controlled model heading angle manually.

8.0 DESCRIPTION OF THE SEAKEEPING TEST PROGRAM

The test program consisted of a zero speed drift run in nominally beam seas plus runs at two forward speeds (nominally 4 and 8 knots full scale) at five headings with respect to the dominant incident wave direction per speed, where180 degrees is defined has a head sea:

Forward Speed (m/s MS//knots FS)	Heading Angle (degrees)
0/0 (drift)	90 (initial heading)
0.9495/4.0	205 / 210 / 245 / 65 / 25
1.899/8.0	200 / 210 / 75 / 60 / 20

The heading angles were derived after careful examination of the directional wave data and ship heading angle data acquired during the ‘Atlantic Swell’ full-scale seakeeping sea trials as well as after reviewing the results of numerical simulations. A Run Log that includes the Video Log is provided in Appendix E.

To achieve the longest available run length, the model acceleration system was moved to various locations around the tank. Matching two identical irregular waves with different dominant directions also provided some flexibility in positioning the launch system and achieving an optimum run length. Sketches of model launcher position and nominal course for each forward speed and heading angle along with the Test Plan are presented in Appendix F.

Whenever the launch system was moved, the model control computer, cabling and associated equipment was also moved. The ideal control position is behind the launching system so that the model operator has a view of the model from astern.

Typical Run Sequence:

Carrying out a free running model experiment in the OEB is a labour intensive effort. The following personnel are required:

- Operator of video camera View #1 or #2 (whichever provided the better view for the given run direction).
- Individual operating the model remotely via portable wireless control device.
- Individual attending the model restraining line.
- Individual in the OEB control room operating the data acquisition system (DAS) and wave generator computer, as well as manually adjusting video camera View #3 during the actual run.
- Individual carrying out the online data analysis - reviewing the acquired data after each run using a dedicated workstation in the OEB Control Room.

Often, due to a shortage of available staff, the individual carrying out the online data analysis between runs also operated the manually directed video camera on the south side.

A typical run sequence is provided as follows:

1) All team members take their positions.
2) With model in the start position and model launch system weights elevated to their required height, the wave generation signal is loaded and wavemaker span set to no (0%) stroke.
3) Data acquisition is triggered which commences (and synchronizes) execution of the wave drive signal. Since the wavemaker stroke is set to 0%, no physical waves are generated. Calm water data is acquired until the delay interval has passed. The delay interval is equal to the sum of all ‘constant speed’ wave data acquired up to that point for a given condition, less a suitable period to allow the irregular wave train to build and traverse the tank to reach the model. Since the entire wave spectrum cannot be covered in a single run, this process is necessary to ensure that seakeeping data for the whole spectrum is acquired in an efficient manner using a series of wave segments.
4) When the required delay interval has passed, the wavemaker span is increased to 100% and physical wave generation begins.
5) About one minute of waves is permitted to pass the model with the model constrained in the launcher.
6) The model shaft speed is adjusted to the desired value however the model is restrained in the launcher by the tag line attached to the stern.
7) Video recording is commenced on all the DV cameras.
8) The model is released and accelerated forward using the model launch system.
9) The model is propelled down the tank with the operator manually maintaining the desired heading angle but with some unavoidable lateral drift depending

of the relative wave heading. The model planar position is tracked using QUALISYS. The video camera operator is manually tracking the model and zooming in/out as required optimizing the image.

10) Within a few metres of the end of the tank, the restraining line arrests the model, and the shaft speed is cut. Video recording, wave generation and data acquisition is terminated.

11) The model is towed manually back to the starting position using the tag line and the propulsion system/rudder control used to manoeuvre the model into the launcher cradle. A wait time of 12 minutes between runs is required to permit the tank to settle to calm. A varying number of runs are required to complete a Run Sequence (forward speed, direction with respect to the incident waves combination).

The zero speed drift runs were executed by merely setting the model nominally at 90 degrees to the dominant wave direction near the west end of the tank and acquiring data until the model either drifted too close to an obstruction or the tank perimeter, or acquisition of 18 minutes full scale data was complete. No tag line was connected to the model during drift speed runs.

In addition to the runs in waves, a number of dedicated roll decay experiments were carried out in calm water at zero forward speed as well as 4 and 8 knots. The model was manually stimulated in roll by depressing the main deck at the maximum beam. Pitch decay runs were also carried out at zero forward speed in calm water by manually depressing the bow to stimulate the model in pitch.

9.0 DATA ANALYSIS

A description of the data analysis process is provided as follows:

9.1 Online Data Analysis

The data were acquired in GDAC format (*.DAC files) described in References 16, 17. The following online data analysis command procedure was executed on a workstation in the OEB Control Room immediately after each run to verify the integrity of the acquired data:

- All measured channels from instrumentation, south and west wave board monitoring channels, plus signal dropout ‘RMS error’ monitoring channel (QUALISYS) were converted from GDAC to GEDAP format (described in Reference 18) and scaled to full scale units using Froude scaling laws (scale factor 4.697).
- QUALISYS data was despiked to remove most of the signal dropouts.
- Dedicated MotionPak motions analysis software was run generating six degrees of freedom motions at the model center of gravity (CG) in an earth fixed co-ordinate system using a value for low frequency cut-off (F1) of 0.05 Hz. Since the MotionPak unit was fitted at the location of the nominal model

CG, it was not necessary to move the computed motions to a new location. The following 18 channels were output: three orthogonal angular accelerations/rates/angles (roll, pitch and yaw) and three orthogonal linear accelerations/velocities/displacements (surge, sway and heave).

- A routine was executed to transform QUALISYS linear displacements (X, Y, Z) to the model CG.
- A routine was executed to compute two model speed channels (in full scale m/s and knots) from QUALISYS planar position (X, Y) data.
- The following five data channels were plotted on the screen in the time domain - shaft speed, forward speed, data signal loss, and X, Y planar displacement. Time segments of steady state data were interactively selected to determine start time (T1) and end time (T2) for statistical analysis.
- The following entire time series were plotted for review:
    - Plot #1: six QUALISYS acquired model motion channels (3 orthogonal linear displacements, roll, pitch and heading angle)
    - Plot #2: six MotionPak acquired model motion channels (3 orthogonal linear accelerations, 3 orthogonal angular rates)
    - Plot #3: QUALISYS signal integrity channel, south wave board monitoring channel and the four wave probe channels
    - Plot #4: west wave board monitoring channel, model speed over ground (m/s), rudder angle, shaft speed, bow vertical and lateral acceleration channels
    - Plot #5: six of the computed MotionPak motion channels – (3 orthogonal angles, 3 orthogonal linear accelerations)
- Basic statistics (minimum, maximum, mean, standard deviation) were computed for all measured and computed channels for the interactively selected time segment.
- The five time series plots and table of basic statistics were output to a local laser printer in the OEB Control Room and statistics were stored in an ASCII format file in the project directory. An example of the online analysis data product is provided in Appendix G.

Additional quality checks carried out manually by reviewing the statistical and time series data included:

- Verifying the value of the shaft rps, model forward speed, heading angle as being correct.
- Comparing the standard deviation of the motion channels measured by QUALISYS and MotionPak.
- Reviewing the signal integrity channels for evidence of signal loss. If significant signal loss was detected during critical segments of the run, the run was normally repeated.
- Plotting and comparing the pitch and roll angle data output from QUALISYS on the same time base as the integrated roll and pitch rate data from MotionPak.

9.2 Offline Data Analysis

1) Basic offline data analysis:

- All measured channels from instrumentation plus dropout monitoring channel 'RMS error' (QUALISYS) and wave board monitoring channels were converted from GDAC to GEDAP format (described in Reference 18) in model scale units.
- The model scale data was converted to full scale using Froude scaling laws. (scaling factor = 4.697).
- The rudder angle and shaft speed channels were low pass filtered using a high frequency cut-off value of 3 Hz to remove signal noise.
- The QUALISYS data was despiked to remove most of the dropouts.
- An extended time segment was selected (T1 = actual run time – 100 s, T2 = actual run time + 100 s) on the six acquired MotionPak channels for MotionPak analysis as the first 5% and last 5% of the data is discarded due to the merging process used.
- Dedicated MotionPak motions data analysis software was run to compute motions at the CG in an earth fixed co-ordinate system using a value for low frequency cut-off (F1) of 0.05 Hz. Since the MotionPak unit was fitted at the location of the nominal model CG, it was not necessary to move the computed motions to a new location. The following 18 channels were output: three orthogonal angular accelerations/rates/angles (roll, pitch and yaw) and three orthogonal linear accelerations/velocities/displacements (surge, sway and heave).
- A routine was executed to transform QUALISYS linear displacements (X, Y, Z) to the model CG. QUALISYS motions were derived at the base of the stern marker for Run Sequence #1 to 3 thus computed motions had to be moved 4.2495 m forward, 0.7866 m down (full scale) to the nominal CG location. QUALISYS motions were derived at the nominal CG location for Run Sequence #4 to 10 and all zero speed drift runs, and thus no transformation was required for these runs.
- Final time segments were selected on all acquired and computed channels using steady state data time intervals (T1, T2) derived during the online data analysis.
- A 3 degree of freedom (DOF) polynomial was fitted to the QUALISYS X and Y displacement channels to smooth out anomalies in data.
- A routine was executed to compute the model speed channels (m/s, knots) from the smoothed QUALISYS planar position (X, Y) data.
- A 3 DOF polynomial was fitted to the derived model speed channel (knots).
- A routine was executed to transform the MotionPak yaw angle to the wave incident angle.
- Data from only the following 16 channels were output:

	CHANNEL DESCRIPTION	UNITS
1]	North Center Wave Probe	m

2] Shaft RPM	RPM
3] Rudder Angle	deg.
4] MP_Surge_Displacement	m
5] MP_Surge_Acceleration	m/s^2
6] MP_Sway_Displacement	m
7] MP_Sway_Acceleration	m/s^2
8] MP_Heave_Displacement	m
9] MP_Heave_Acceleration	m/s^2
10] MP_Heading_Angle	deg.
11] MP_Yaw_Velocity	deg./s
12] MP_Pitch_Angle	deg.
13] MP_Pitch_Velocity	deg./s
14] MP_Roll_Angle	deg.
15] MP_Roll_Velocity	deg./s
16] Speed	knots

2) All 16 channels for each run were merged with other run segments that make up the given Run Sequence using a fixed 3 s merging overlap between each segment to ensure a relatively smooth transition. The result is a final file/channel that spans the entire nominal 18 minute full scale wave spectrum. The number of segments required to cover the wave spectrum was dependant on the incident wave direction and model forward speed.

3) Each of the merged channels was reviewed on a computer screen in the time domain and edited manually to remove any remaining spikes by interactively selecting the beginning and end of the glitch, deleting the undesirable data - then using a linear interpolation utility to fill the gap. Any major motion anomalies such as large transient motions at the beginning of a run were identified and avoided during further analysis. This often resulted in a shorter run segment.

4) Once all the spikes and anomalies were removed, the basic statistics (minimum, maximum, mean, standard deviation) were computed for all 16 channels, the number of wave encounters determined by carrying out a zero crossing analysis on the heave acceleration channel, and the significant wave height/spectral period of the north center wave probe data determined by executing a variance spectral density analysis on this channel using 22 degrees of freedom. This information was subsequently output in tabular form.

Example time series plots for each merged channel for a typical 4 and 8 knot Run Sequence are provided in Appendix H. Tables of basic statistics for each merged run are provided in Appendix I while a summary of the seakeeping motion (Standard Deviation) results are provided in Table 4. Plots of the standard deviation of roll and pitch angle as well as heave acceleration versus heading angle are presented for forward speeds of 4 knots (Figure 9) and 8 knots (Figure 10).

9.3 Roll and Pitch Decay Analysis

The analysis methodology for a series of motion decay runs carried out January 25th is presented in this section.

9.3.1 Roll Decay Analysis

The roll decay runs were analyzed using dedicated software to compute the equivalent viscous damping. Three runs were carried out in calm water at zero forward speed, 4 knots and 8 knots. The output from the analysis is stored in Appendix J. Initially, the QUALISYS roll angle channel was reviewed in the time domain. Each of the three roll excitations was isolated and separated out into individual GEDAP files. Each roll excitation segment was analyzed omitting the first half cycle and all very low amplitude cycles. The data was then low pass filtered prior to carrying out the following analysis procedure:

The roll decay analysis algorithm computes viscous equivalent damping. Peaks and troughs data are input, and log decrements are computed as the natural logarithm of the ratio of two successive amplitudes. Both crests and troughs are used in calculating log decrements to increase the computational accuracy - especially in cases where only a few decay cycles can be measured. Damping ratios are calculated from the log decrements whereby the damping ratio for linear damping is estimated as the average of these log decrements. The damping ratio for non-linear damping is modeled in the form:

zeta = B1 + B2 * X

where zeta = damping ratio
B1 = equivalent damping linear term
B2 = equivalent damping non-linear term

If the damping is linear, B2 = 0 and B1 is equal to the damping ratio for linear damping.

The equivalent damping terms are estimated by fitting a linear regression line through the damping ratio versus amplitude values. The equivalent damping linear term is the y intercept of the regression line. The equivalent damping non-linear term is set to be the slope of the regression line. The program uses the equivalent damping linear and equivalent damping non-linear terms to compute the equivalent damping envelope for the decay series.

The following plots were generated:

1) Roll Angle vs. Time Plot: illustrating the raw data, the filtered decay series, the equivalent damping curve, the mean value and the detected peaks and troughs.

2) Damping Ratio vs. Roll Amplitude Plot

3) Roll Period vs. Roll Amplitude Plot

The following two tables were also generated for each excitation:

1) Table listing the offset, average period, linear damping coefficient, equivalent damping slope and the equivalent damping offset for the entire selected time segment.

2) Table listing for each half cycle: amplitude, amplitude-offset, damping ratio, and period for each trough and crest in decay series.

The results of the roll decay analysis is summarized in Table 5. The average roll period (average of excitations #1, 2 and 3) is 3.1996 s (zero forward speed), 3.2126 s (4 knots), and 3.2639 s (8 knots). Note the accuracy of the results declines as the forward speed increases due to the reduced number of available cycles.

9.3.2 Pitch Decay Analysis

A different methodology was used to analyze the three zero speed pitch decay excitations due to the fact that there was only really one quality cycle available for analysis. The following data analysis methodology was adopted:

A damped sine wave was fitted to the time series of measured data using the least-squares criterion. The fitted curve was defined as follows:

$$Y2(t) = Y0 + A * SIN(2*\pi *f*t - \varphi) * \exp(-t/\tau)$$

where Y0 = mean value of sine wave,
A = amplitude of sine wave,
f = frequency of sine wave in Hz
φ = phase lag of sine wave
τ = damping time constant in seconds.

The nondimensional damping ratio $\zeta = 1/(2*pi*f*\tau)$ was also calculated which defines the damping for a second order system of the following form:

$$m * d(dY/dt)/dt + c * dY/dt + k * Y = F(t)$$

where m = mass,
c = linear velocity damping factor,
k = linear restoring force constant (spring constant)
Y(t) = linear displacement of mass m

$F(t)$ = external force.

$\zeta = r/p$ where $r = c/(2m)$ and $p = (k/m)^{1/2}$ = natural frequency in radians per second.

Initial values of the parameters Y0, A, f, φ and τ were estimated from a zero-crossing analysis of the input time series. The initial estimate for φ was obtained by integrating Y1(t)*sin(2* π *f*t) and Y1(t)*cos(2* π *f*t) over an integer number of zero-crossing cycles where Y1(t) was the input time series. The final values of Y0, A, f, φ and τ were obtained by using the Downhill Simplex Method to minimize the mean square deviation between the measured time series and the damped sine wave. Thus, the five parameters Y0, A, f, φ and τ were chosen to minimize H where:

H = Sum for j = 1 to N of [Y2(t(j)) - Y1(t(j))]**2

and N was the number of points in the input time series Y1.

The time series plots of the pitch decay data are included in Appendix J where the solid line on each plot is the raw data and the dashed line is the fitted damped sine wave. Comparing these two curves provides a visual indication of the quality of the fit between the damped sine wave and the measured data. The result of the pitch decay analysis is also summarized in Table 5. The average pitch period (average of excitations #1, 2 and 3) is 2.8447 s. Note the accuracy of the results is tempered by the fact that there is only a single cycle available per excitation.

9.4 Seakeeping Data Verification Process

Comparison of QUALISYS and MotionPak Motions:

Comparisons in the time domain were made between motions measured by QUALISYS and MotionPak – specifically roll angle, pitch angle, heading/yaw angle and heave (Z) displacement. Example time series comparative plots are provided for RUN_211 (65 degree heading angle, 4 knots, Run Sequence #6) in Appendix K. Note that the data was tared where necessary. Statistics computed for the selected segments from RUN_211 are presented in Table 6.

Comparison of MotionPak Output to Bow Acceleration Signals:

Example time series plots comparing vertical and lateral accelerations as measured directly by the accelerometers fitted at the bow to the accelerations computed at the bow location using the data from the MotionPak for run segment RUN_211 (65 degree heading angle, 4 knots, Run Sequence #6) is also included in Appendix K. The data from the bow accelerometers had to be tared and the units converted from g's to m/s^2 while the MotionPak accelerations were transformed from the model center of gravity to the location of the bow accelerometers, and output in the body fixed co-ordinate system. Statistics for the entire selected run segment are provided below:

	Units	Minimum	Maximum	Mean	Std. Dev.	% Diff. Std. Dev.
MotionPak Heave	m/s^2	-1.0931	0.96115	-0.04309	0.34499	2.52
Bow Z Acceleration	m/s^2	-1.1243	0.99748	0.0	0.35391	*******
MotionPak Sway-	m/s^2	-1.8370	2.0964	-0.0036	0.67049	1.02
Bow Y Acceleration	m/s^2	-1.7983	2.0661	-0.0011	0.66364	*******

Review of North Center Wave Data:

To get some appreciation of the wave quality and consistency throughout the test program, a review of the wave statistics as measured by the north center wave probe is provided for each run sequence. The difference between the measured wave statistics and wave match statistics (Table 7) as well as measured statistics and wave target statistics (Table 8) are listed.

10.0 COMPARISON OF FULL SCALE, PHYSICAL MODEL AND NUMERICAL MODEL DATA

A comparison between the results of the full scale trials data described in Reference 1, physical model data collected in the OEB and numerical model results are presented in this section. Numerical simulations were carried out by MUN using the non-linear time domain code MOTSIM described in Reference 12. An initial correlation of the seakeeping data with full scale trials results, preliminary physical model results and numerical predictions is provided in Reference 13.

A summary of the physical model data is provided in Table 9. Summary predictions of motion statistics for the October 4, 2003 sea state conditions output from MOTSIM are provided in Table 10 while a summary of full scale sea trials data from Reference 1 is given in Table 11. Note that all values in these tables are significant values computed as twice the standard deviation. Also note that in Tables 9 to 11, the heading angle convention is defined as the one used for the MOTSIM predictions.

Comparison plots of significant vessel motions measured full scale, physical model (both MUN and IOT defined waves) as well as motions predicted using MOTSIM versus heading angle are provided for forward speeds of 4 knots (Figures 11 to 17) and 8 knots (Figures 18 to 24). To gain some insight into the heading control attributes, plots of rudder and yaw angle (standard deviation) versus heading angle for the two forward speeds have also been plotted (Figures 25, 26). Statistics of rudder and yaw angle are listed in Table 12.

11.0 DATA CORRELATION DISCUSSION

In an ideal world, there would be a perfect correlation between data collected full scale, using a scaled geosimilar physical model and the output from numerical prediction software. To evaluate the seakeeping attributes of a new marine platform, the designer would fabricate a scale model, and test it over a limited range of regular and realistic irregular wave environments that the vessel is likely to encounter in its proposed operating area. Subsequently, an input file describing the geometry and including the static and dynamic stability attributes of the new design would be prepared, a test plan derived and the physical model data acquired used to iteratively tune a numerical model. Once the designer is satisfied with the performance of the numerical model, the seakeeping attributes of the new design would be assessed using the numerical tool over a wide range of realistic sea conditions to ensure the vessel conforms to the design criteria established by the ultimate operator. Finally, verification trials that demonstrate the ship meets the design requirements are carried out. In reality, there are factors that degrade the accuracy of the data derived from both physical experiments and numerical models. Ultimately the designer must be aware of the deficiencies inherent in each experimental tool and take this into consideration when evaluating the data product generated. In this section, primary error sources are discussed based on the experience derived from the ‘Atlantic Swell’ correlation effort and recommendations made that will result in improvements in the correlation in future.

11.1 Full Scale Data

Although the goal of the modeling process is to generate data that reflects the results collected full scale, the experimentalist must be aware of the factors that degrade the full scale data and take this into consideration when evaluating integrity of the overall correlation. The factors that are believed to have degraded the full scale data set collected on the ‘Atlantic Swell’ are discussed in this section.

- No Autopilot

This small fishing vessel was not fitted with an autopilot and thus the entire trial was carried out on manual steering. The steering was somewhat erratic in nature with yaw angles often exceeding ± 40 degrees and standard deviation in the order of 15 to 25 degrees (see Figures 25, 26). It appeared that perhaps the helmsman was instinctively steering to mitigate vessel motion rather than attempting to maintain a desired course. The physical model was also manually controlled however the yaw angles recorded were generally less than ± 10 degrees. It was also noted that the quality of the steering, both full scale and model scale, varied with the skill of the operator. Thus the operator skill level became an important factor in the experiment. The numerical model cannot emulate the behavior of a human helmsman and thus the gain factors of an autopilot are input in an effort to simulate the behavior of the helmsman. The difference in steering control between the full scale ship and the physical/ numerical models is assumed to have a significant negative impact on the correlation – especially for yaw and roll angle.

- Limitations on Wave Buoy Accuracy at Low Frequency

Overview of directional wave spectrum data from Reference 19:

Wind generated ocean waves have a period ranging from 2 s to 30 s with the longest period waves being generated by very strong winds that blow for long periods from a nominally constant direction. The sea is spread about the wind direction in a symmetrical fashion such that there is less wave energy for greater angles away from the primary wind direction. Weak winds produce only short wave length, high frequency waves. Stronger winds blowing from a nominally constant direction will, over time, generate not only high frequency waves but also lower frequency waves with longer wavelengths. In the area where the waves are generated, directional spreading is relatively large with a considerable portion of the waves propagating to the sides of the predominant wind direction.

Large storms can produce a low frequency swell that can propagate large distances from the storm center. High frequency waves die out more quickly than low frequency waves. A low frequency swell generated a long distance from the wave buoy can have a narrow directional spread.

Directional wave data acquired by the MUN wave buoy are calculated from the roll/pitch motion of the buoy using standard techniques described in published papers such as Reference 20. Wave surface tilt activity due to low frequency (frequency < 0.1 Hz) wave motion is quite small and thus the pitch and roll amplitudes the sensors must measure are small. This results in a signal-to-noise ratio in the buoy instrumentation so small that wave direction is not measured accurately in the low frequency bands resulting in some potential inaccuracies in defining the overall wave environment. This full scale low frequency wave measurement deficiency may result in motion measurement errors in the physical and numerical models if there is a significant difference in the modeled wave environment.

- Variation in Full Scale Sea State with Time

It would be convenient if the sea state remained constant for the duration of any given seakeeping trial however the reality is that the local sea conditions are constantly changing under the influence of variation in ambient wind speed/direction, current/tide and far-field influences. The variation in wave statistics as measured by the wave buoy on October 4, 2003 is outlined in Table 13. The sea was fairly confused and the wave direction was also changing over time. This is not uncommon especially when the trial is being carried out close to an irregular coastline. Selecting relatively short run lengths to cover the five directions relative to the incident seaway for any given speed in roughly two hours, mitigates the impact of variation in sea conditions on the overall trial results.

- Wave Buoy Mooring Issues

The MUN wave buoy was originally designed for short-term deployment from small boats to supply data in support of near-shore naval operations. The deep water mooring was designed by MUN Oceanography staff and reviewed by the buoy designers. Every effort was made to mitigate any negative impact of the mooring on the operation of the buoy however it is conceded that the integrity of the wave height data may be somewhat compromised. An alternative strategy would be to deploy the buoy free floating although this would involve additional complications and risks as this buoy is not fitted with flashing light or radio beacon.

- Wave Buoy Failure

The Neptune wave buoy failed during the trial with the last wave data acquired at 10 AM Newfoundland time on October 4th. An attempt was made to linearly extrapolate the data based on the observed trend (see Figure 27 and table below) however it is safe to assume that only a rough estimate of wave conditions is available for the 8 knot runs carried out in the afternoon of October 4th. After a review of numerical simulations performed on the vessel after the trial, a decision was made to reduce the significant wave height as measured at 10 AM the morning of the trial by 20% and use this as a basis for generating the waves for the 8 knot runs in the OEB. This lack of acquired wave height and direction data is assumed to have a significant negative impact on the correlation for all the 8 knot runs.

NF Time	0.00	2.00	4.00	6.00	7.50	8.00	8.50	9.00	9.50	10.00	11.00	12.00	13.00	14.00
Sig. Wave Height (m)	2.39	2.07	1.85	1.8	1.63	1.51	1.56	1.48	1.37	1.38	1.263	1.163	1.063	0.963

PROJECTION OF WAVE HEIGHT BASED ON LINEAR TREND

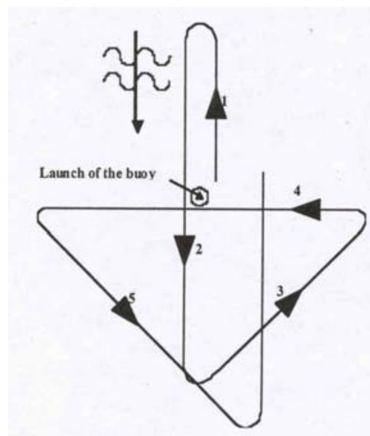
- Estimation of Dominant Wave Direction

Locally generated waves may co-exist with one or more low frequency swells from one or more far-field wave generation areas. Swells originating in other areas and locally generated waves often emanate from different directions and result in one or more peaks in the wave energy spectrum. The consequence is a confused sea where the dominant wave direction is difficult to determine. On the 'Atlantic Swell' trial, the dominant wave direction was assessed visually at the start of each forward speed Run Sequence and, once defined, the vessel proceeded on the specified five courses with respect to the waves. During the trial it became apparent, however, that the dominant wave direction was either changing with time or was not defined correctly to start with.

- Spatial Variation in Wave Field

The moored wave buoy measures the wave height and direction at a single point however it is safe to assume that there is a spatial variation in these parameters throughout the trials area. The variation in wave characteristics was mitigated by the fact that the water depth was relatively constant throughout the trials area, however. In addition, a run pattern (illustrated below) as recommended by the ITTC (Reference 21) was adopted that resulted in data collection as close to the moored wave buoy as feasible. As noted in Reference 1 however, the helmsman made a steering error during the 4 knot Run Sequence resulting in selection of the wrong course when turning from a bow sea onto a beam sea heading. The consequence of this error was the beam sea run being 180 degrees different than desired and the subsequent quartering sea runs being carried out several kilometers from the wave buoy.

Run 1: Head Sea
Run 2: Following Sea
Run 3: Bow Sea
Run 4: Beam Sea
Run 5: Quartering Sea



- Variation of Ship's Speed

During the October 4th seakeeping trial, an effort was made to vary the propeller shaft speed to maintain a constant speed over ground for a given heading angle with respect to the incident wave. Once the shaft speed had been selected, it remained constant throughout the run.

Average measured shaft RPM and speed over ground (from Reference 1):

Head Sea: Shaft RPM: 227, Forward Speed: 4.0621 knots
Bow Seas: Shaft RPM: 262, Forward Speed: 4.069 knots
Beam Seas: Shaft RPM: 325, Forward Speed: 4.235 knots
Quartering Seas: Shaft RPM: 335, Forward Speed: 4.281 knots
Following Seas: Shaft RPM: 303, Forward Speed: 3.904 knots

Head Sea: Shaft RPM: 541, Forward Speed: 7.901 knots
Bow Seas: Shaft RPM: 553, Forward Speed: 7.438 knots
Beam Seas: Shaft RPM: 506, Forward Speed: 8.404 knots
Quartering Seas: Shaft RPM: 583, Forward Speed: 7.341 knots
Following Seas: Shaft RPM: 574, Forward Speed: 7.800 knots

Thus even though there was an effort to maintain constant forward speed by varying the shaft speed, some appreciable variation in forward speed was noted – especially at 8 knots.

- Variation in Static Stability, Draft

As the trial progresses, the vessel is burning fuel oil and using other consumables. Consequently, there is often some variation in fluid free surface with resulting change in static and dynamic stability characteristics as well as a small change in draft. Other activities being carried out by the crew during the trial may also have an undesirable impact on the ship's condition. On a small vessel such as the 'Atlantic Swell', even shipboard personnel moving around during the trial would have some impact on the static stability.

- Estimate of Static Stability (GM_T)

An inclining experiment was carried out on the 'Atlantic Swell' two days prior to the sea trial to estimate the static stability of the vessel (Reference 1, Appendix A). The experiment was complicated by the fact that there is no draft marks and very limited geometry information available for this vessel. There were a lot of questions regarding the integrity of the information in the inclining report. It was never possible to match the model LCG with the value provided in the inclining report.

- Inherent GPS Inaccuracies:

IOT used the Global Positioning System (GPS) with a differential correction signal from a CCG source to provide the most accurate data available for determination of course and speed over ground (COG, SOG). Typical errors that can be incurred with and without applying the differential correction (DGPS) are provided below from Reference 22:

Summary of GPS Errors – in metres per satellite signal acquired:

Typical Error	Standard GPS	Differential GPS
Satellite Clocks	1.5	0
Orbit Errors	2.5	0
Ionosphere	5.0	0.4
Troposphere	0.5	0.2
Receiver Noise	0.3	0.3
Multipath	0.6	0.6

Note that the above listed errors are for absolute position (i.e. latitude, longitude) whereas for any sea trial, the short term relative position accuracy is what is important and these errors are difficult to quantify. Although the GPS errors are certainly mitigated by using the differential correction signal, they are not eliminated entirely. The actual error incurred changes over time depending on ambient atmospheric conditions, number of satellite signals acquired, GPS receiver noise attributes and time dependent configuration of the satellite constellation in view. The errors can either cancel out or be cumulative. Multipath error occurs when the incident satellite signals bounce off adjacent ship superstructure.

Not much can be done to improve the performance of DGPS and using alternative tools to measure these parameters is not recommended as DGPS is by far the most cost effective means of acquiring quality position, speed and course data anywhere in the world.

- Location/Alignment of Sensors

One of the challenges when installing sensors on a ship is accurate determination of their location and alignment in a ship co-ordinate system. Normally, the position of motion sensors (MotionPak, accelerometers…) and the GPS antenna are referenced relative to the nominal center of gravity and/or aligned with the ship's longitudinal axis. There were few alignment references on the 'Atlantic Swell' and thus only a rough alignment of the sensors was possible.

11.2 Physical Model Data

- Model Geometry

Models are milled from foam using computer generated tool paths and glassed as described in the Reference 11. The model geometry is verified using the following strategy (also from Reference 11):

Hulls are checked for surface bumps and hollows using 10 section templates as well as stem and stern profiles. The templates and profiles are cut from 5 mm plastic sheet using the same milling machine that was used to mill the hull. The overall principal dimensions for the length between perpendiculars, depth, maximum beam are measured by hand with squares, levels, rulers and measuring tape.

The measured dimensions and the gaps between the templates and the hull surface should be within the following specified tolerances:

- *template gap less than 2 mm below the waterline*
- *principal dimensions - ± 1 mm on dimensions < 2000 mm and ± 0.05% on dimensions > 2000 mm*

Appendage locations are drilled/milled using the milling machine and positioned within ± 0.25 mm.

The hull offsets for the 'Atlantic Swell' were obtained from manual measurements, as there were no drawings of the vessel available. The displacement of the faired hull derived from these offsets could not be matched:

Inclined Displacement: 16.61 Long Tons
– inclining weights consisted of two * 505 lb drums – 458 kg total
Model scale displacement = 158.45 kg from inclining experiment
Model scale displacement from IOT computed hydrostatics = 151.7 kg

In addition, the location and dimensions of the ship appendages was often only a rough estimate from viewing photographs of the vessel on dock (see Figure 28).

- IOT Stock Propeller

The IOT stock propeller selected for use on the Model #IOT651 was close to the desired diameter however rotated in the opposite sense to the propeller installed on the ship resulting in an induced hydrodynamic yaw moment opposite to the one experienced on the 'Atlantic Swell'.

- Propeller Shaft Rake

The shaft rake on the model was determined from the CAD drawing to be 4 degrees however due to an error in interpreting the information provided from the contractor, the actual shaft rake was supposed to be 3.62 degrees.

- Setting Model Stability and Displacement Attributes

One of the greatest challenges in outfitting a physical model is including all the required outfit items in a small volume without exceeding the target displacement limit, deviating from the correct draft and trim, as well as ensuring that the distribution of the weight components results in the desired static and dynamic stability attributes. For the 'Atlantic Swell' experiments, there was no ballast weight available to adjust the model static and dynamic stability as the entire available weight envelop was absorbed in required outfit. To meet the demanding weight target, outfit design changes and dedicated batteries of less weight than the usual batteries used by IOT were used. Adjusting the layout of the batteries was the only means available to attain the desired weight distribution. Long battery cables were necessary to facilitate fitting the batteries in the required position. In the end, a compromise between achieving the model scale target GM_T and roll period was required:

Target GM_T: 28.72 cm	Achieved GM_T: 29.25 cm
Target Roll Period: 1.487 s	Achieved Roll Period: 1.476 s

NOTE: model roll period as determined for zero forward speed in OEB.

The achieved stability attributes are fairly close given the constraints on the model design.

- Wave Matching Issues

There are a number of issues related to emulating a real multi-directional wave spectrum in the OEB that have an impact on the overall quality of the generated wave including:

- The wave is matched at a single point in the center of the tank and there is a spatial variation in the wave parameters over the tank area as illustrated by the matched wave statistics for all the wave probes provided in Appendix L.
- Some errors are introduced when a number of segments are combined to make up a single Run Sequence and there is a general correlation between the number of segments and deviation from target (Tables 7, 8).
- Only three waves acquired during the morning of October 4th were matched and used for all experiments although there was some variation in wave properties noted full scale over the time frame of the data collection. The compromise was especially significant for the 8 knot runs carried out during the afternoon of October 4th as there was no measured wave data available for the runs. An estimate of wave data from 10 AM wave buoy file with 20% lower significant wave height was used as a rough approximation of the October 4th afternoon wave environment.
- A nominal spreading angle is selected whereas the real spreading angle was also changing with time.
- The especially confused full scale sea apparent on October 4th.
- The challenge in emulating the high frequency wave components in the OEB. The full scale roll natural frequency of the 'Atlantic Swell' was ~ 0.31 Hz and it was not possible to include significant energy at this frequency due to limitations of the OEB wavemakers.

The process of emulating a full scale confused sea in a small wave basin results in unavoidable compromises in wave quality with a resultant significant negative impact on the correlation.

- Propulsion Motor Power

There was insufficient power available on the model to propel the model at 8 knots full scale. The maximum achievable speed in waves was 7.2 to 7.5 knots full scale.

- Forward Speed Control

For a fixed shaft speed, the vessel forward speed will vary over the course of an irregular wave as the ship encounters periods of relative calm followed by a sequence of higher waves. Since a number of runs are required to cover the entire wave spectrum due to the size limitation of the OEB, there is a variation in forward speed between runs. The model is accelerated using a launch mechanism to minimize the acceleration phase and maximize the run length. It is difficult to estimate in the model test planning phase what suitable shaft speed is required such that, when all the runs of a given Run Sequence are appended together and the average speed of all the runs are computed, the average computed speed matches the target scaled ship speed. Any difference in forward speed between the full scale and model scale degrades overall the correlation. It should also be noted that the impact on motions of any difference in speed between the ship and physical model is often nonlinear. A 0.5 knot difference at 4 knots, for example, will not have the same impact on the correlation as a 0.5 knot difference at 8 knots primarily due to the nonlinear nature of the lift damping.

The variation in full scale forward speed is given in Section 11.1 while the variation in model scale forward speed is provided in Table 9.

- Uncertainty Analysis for Instrumentation

A detailed investigation into the measurement uncertainties inherent in a physical model motions instrumentation package is described in detail in Reference 23. Both systematic (fixed) and random (precision) uncertainties associated with measured motions (roll angle, pitch angle and heave acceleration) were calculated. The analysis indicated that total uncertainties are in the 1-2% range. Compared to other sources of error such as replicating the desired wave environment, the uncertainties inherent in the instrumentation and data acquisition are small.

11.3 Numerical Model Data

Many of the same simplifications that apply to the physical model experiments were also an issue with the numerical model:

- the hull form was derived from a set of manually derived offsets and thus there are no doubt some inaccuracies in the geometry of the input file as there were with the physical model;
- the same issues regarding estimating the sea state from wave buoy data must be addressed although the numerical model does not have the reflection or wave field variation issues that were noted in the OEB;
- it is not possible to emulate the performance of a human helmsman in a numerical model and thus autopilot gain factors are input.

Listing of the many other simplifications incorporated into numerical prediction codes is beyond the scope of this report.

Although there are several simplifications inherent in executing a simulation with a numerical model, for the ‘Atlantic Swell’ trials the difficulty in representing the sea state is thought to be the primary source of error.

11.4 Summary of Correlation Discussion

A summary of the primary factors that impact on the correlation is provided as follows:

Full Scale Data:

For seakeeping, by far the most important issue with respect to the correlation is the integrity of the wave data. The variation of the wave field with time, the spatial variation of the wave field along with the actual measurement issues associated with a moored directional wave buoy combine to provide a challenge in quantifying the environmental excitation. The fact that heave is significantly under predicted model scale and the peak roll amplitude is offset in terms of wave direction implies that the wave buoy mooring may have had an undesirable influence on the full scale directional wave data acquired.

The lack of an autopilot on the 'Atlantic Swell' is also assumed to be a significant correlation complication given the rather erratic steering noted.

Physical Model Data:

For the seakeeping tests, emulating a real multi-directional wave field in the relatively small OEB is compromised by the inevitable spatial variation in the field combined with beach reflection induced anomalies. Dedicated research is required to address these issues and collaboration with other wave basins facing similar challenges is recommended.

The other major limitation related to carrying out seakeeping experiments in the OEB is the relatively short run lengths and small model scale. Ongoing efforts are underway to devise test strategies to mitigate the negative aspects of the small basin size.

The poor description of the full scale ship geometry and the difficulty duplication the full scale hydrostatics model scale was also a significant source of error.

The model steering was controlled manually as on the ship however the steering quality model scale was far superior to what was observed full scale. This difference in steering quality is likely a serious source of error especially for yaw and roll motions.

Numerical Model Data:

The greatest challenge in generating a quality numerical simulation appears to be emulating a real multi-directional sea based on data from a directional wave buoy. A secondary complication was the challenge in tuning a numerical autopilot to duplicate the steering performance of a real helmsman.

12.0 DISCUSSION OF OTHER ISSUES

Fitting out a self-propelled, free running model with self-contained propulsion system, power source, radio/telemetry, autopilot capability, rudder servo, instrumentation and ballast is one of the most challenging physical model experiments to perform. The model is packed with equipment yet weight disposition is critical since consideration must be given to achieving the desired draft/trim as well as the correct model static and dynamic stability attributes.

Model Weight:

Although some progress has been made in reducing the weight of conventional models, additional effort is recommended to:

– replace the motor controller with a modern lightweight unit;
– replace the rudder servo with a modern digital unit with programmable azimuth rate.

Model Batteries:

Considerable effort was made to ensure the required batteries could be replaced quickly. Quick disconnects on the battery terminals and quick release latches fitted on the main deck reduced battery change time and it is recommended that these innovations be included on all future seakeeping models. The batteries were strapped down with copper straps fastened with screws to local anchor points and it is recommended that an alternative battery securing arrangement be investigated to facilitate releasing the batteries.

QUALISYS:

Although several improvements have been made to QUALISYS signal quality over the years, including improvements in tank coverage, there are still some signal dead zones and quality issues that need to be addressed.

Model Launcher:

The model launch succeeds in accelerating a model to the desired forward speed thus optimizing the tank size however the unit is somewhat labour intensive to operate and the tag line often gets tangled up. There are plans to improve tag line control using an off the shelf fishing reel and a lighter, stronger line. This initiative should be pursued and some thought should go in to other improvements.

A simple CAD drawing of the model launch system should be prepared suitable for being included in future test reports.

MotionPak:

There are concerns regarding the measurement of six degrees of freedom motions using the MotionPak since if the sign convention of the motion signals is incorrect during calibration, the resultant computed data would be incorrect. The existing MotionPak calibration work instruction (Reference 24) is confusing and often leads to errors. It is recommended that this work instruction be reviewed and revised. It is recommended that a sign convention verification procedure be derived and this verification be carried out in the tank prior to starting any test program.

Model Control System:

The model driver interface is currently married to a MicroSoft 1998 operating system and used on a desktop computer – a computer that is cumbersome to redeploy around the OEB when the model launcher is repositioned. The software should be re-written for an XP operating system and installed on a notebook to make the overall system more portable and facilitate any future upgrades.

Comparison Between MotionPak and QUALISYS Data

A comparison between MotionPak and QUALISYS roll angle, pitch angle, yaw/heading angle and vertical (heave) displacement is illustrated in Appendix K and Table 6. It should be noted that in all cases the QUALISYS data is a direct output while MotionPak angles are integrated angular rate signals and the MotionPak heave displacement is a double integrated heave acceleration signal. There is an excellent comparison between the angular data with a less than 0.5% difference in standard deviation. A difference in yaw/heading angle standard deviation of some 3% would likely be improved if the QUALISYS markers could be placed farther apart on the model. From the example yaw/heading angle time series plot provided in Appendix K, it also appears that the integrity of the QUALISYS data is influenced by model position and/or orientation in the OEB tank co-ordinate system since a review of the time series plot implies that there is excellent comparison for the first 40 s but that the comparison degrades as the model travels down the tank from west to east. The vertical (heave) displacement comparison is poor (> 30% difference in standard deviation). One factor contributing to this poor relationship could be the fact that the MotionPak heave acceleration signal is double integrated and thus somewhat degraded however the large difference warrants further investigation.

Comparison Between IOT and MUN Defined Waves in OEB

As described in Section 7.0, two waves with two different spreading function characteristics were generated – one designated the 'MUN' waves were used for all experiments and the 'IOT' waves used for two run sequences: IOT4_HDG65 and IOT8_HDG200. Reviewing the results of the analysis for the data acquired using these two waves (Table 9 and Figures 11 to 24), it can be concluded that:

- The significant motion values derived for the IOT and MUN waves correspond fairly closely for the 4 knot runs with the exception of roll angle where the IOT wave values were ~ 2/3 that of the MUN wave – and actually much closer to the full scale data.
- For the 8 knot runs, there was significant differences between the IOT and MUN wave statistics – for some motions the IOT wave data was much higher than the MUN wave data (surge and heave acceleration as well as pitch angle) while for the remaining motions the IOT wave data was lower than the MUN wave data.
- The only time the IOT wave motion came close to the full scale data at 8 knots was surge acceleration.

Thus although none of the data correlates particularly well with the full scale data, the MUN wave generally provides a superior overall prediction.

Comparison Between MotionPak and Bow Accelerometer Data

There is a good comparison (< 3 % difference in standard deviation) between accelerations measured by MotionPak at the nominal model CG and by orthogonal linear accelerometers fitted at the bow (see time series plots in Appendix K as well as statistical data in Section 9.4). Most of the difference is likely due to the fact that the X, Y, Z displacement distances between the two sensors was measured using a simple tape measure to an estimated accuracy of ± 5 mm.

Wave Buoy Issues:

During other trials in this research program described in References 3 to 6, wave data was acquired using a moored Datawell directional wave buoy leased from a local private company as well as the MUN Neptune wave buoy. An effort will be made to compare the wave height and direction data from these two sensors in a future report and perhaps, after a review of available literature, a recommendation for an improved mooring arrangement for the Neptune buoy can be derived.

IOT has recently procured a new TRIAXYS™ directional wave buoy from Axys Technologies Inc. of Sydney, BC. Wave data acquired using this new sensor on future sea trials will hopefully improve the overall seakeeping correlation effort.

Correlation Issue:

The correlation of the model scale data with the full scale data from the 'Atlantic Swell' can only be described as very poor. This is especially true for the 4 knot runs and of course yaw angle at both speeds is poor due to the manual steering issues discussed. The overall correlation is a testament to the challenges associated with carrying out full scale trials and physical model experiments on small vessels. Two additional model experimental programs on 65 ft. fishing vessels are planned related to this project and since the full scale wave environment was measured during both of those trials using a different wave buoy and a better description of hull geometry is available for both these vessels, a better correlation between model scale and full scale data is anticipated.

13.0 ACKNOWLEDGEMENTS

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TABLES

Institute for Ocean Technology

Model Accuracy Measurements

Project Number	2017
Client	IOT
Issued By	Tom Hall
Date	March 2005
Model Scale	4.697

Model ID No.	IOT651
Model Description	Fishing Vessel
Model Name	CCGA Atlantic Swell
Measured By	Jim Everard
Verified By	Scott Reid
Approved By	David Cumming

Overall Dimensions

in metres (m)

Principal Dimension Tolerance: +/- 1 mm on dimensions < 2000 mm
+/- 0.05% on dimensions > 2000 mm 0.0005

Dimensions	Design F.S.	Design M.S.	Measured M.S.	Deviation M.S.	Tolerance +/-
LOA	10.411	2.216	2.206	0.01	0.0011
LWL	9.655	2.057	2.057	0	0.0010
Max Beam	4.353	0.9267	0.919	-0.0077	0.0010
Max WL Beam	4.094	0.8716	0.8723	0.0007	0.0010

NOTE: IOT Model Construction Standard GM-1, V9.0 used.

Visual Inspections

Appendages checked	Y
Surface Finish Checked	Y
Turbulence Stimulators Installed	N
Tufts Installed	N

Section Template Measurements

gaps noted in mm

Measured with ____66T_______ Feeler gauge < 2 mm gap tolerance

	Location w.r.t. WL		OK? (Y or N)
Station Number	Above	Below	Y
0	0.5	0.25	Y
1	0.5	0	Y
2	0.25	0.35	Y
3	0.25	0.65	Y
4	0.15	0.15	Y
5	0.65	0.65	Y
6	0.5	0.5	Y
7	0.65	0.65	Y
8	0.5	0.4	Y
9	0.15	0.15	Y
10	0	0	Y

Gaps measured were done in imperial (0.000") and converted to SI units

Table 1: Model IOT651 QA Measurements

IOT Stock Prop P104R QA Data

Revision Date: 3-Jun-04
Propeller #: **P104R**

Measurement Data

	inches	mm
Outside Diameter:	6.472	164.39
Radius:	3.236	82.19
7th Radius:	2.265	57.54
Mass:	0.5774	kg

Hub Particulars

	inches	mm
Length:	1.626	41.30
Large Diameter:	1.090	27.67
Small Diameter:	0.856	21.74
Bore:	0.376	9.55

Pitch Measurement & Calculation

Angle (Degrees)	Height (Inches)	Pitch Angle (Degrees)
2	0.668	
30.5	0.184	23.2461
59	-0.262	21.5950
		22.4255 **(Full Blade)**
92	0.691	
120.5	0.199	23.5886
149	-0.251	21.7707
		22.6857 **(Full Blade)**
182	0.681	
212.5	0.175	22.7644
233	-0.233	26.7212
		24.3851 **(Full Blade)**
272	0.7	
300.5	0.209	23.5459
329	-0.220	20.8438
		22.2079 **(Full Blade)**

Pitch Measurement & Calculation

Angle (Degrees)	Height (Inches)	Pitch Angle (Degrees)
2	-0.25	
33.5	-0.801	23.8666
65	-1.469	28.2087
		26.0779 **(Full Blade)**
92	-0.248	
123.5	-0.799	23.8666
155	-1.469	28.2801
		26.1150 **(Full Blade)**
182	-0.249	
213.5	-0.801	23.9051
245	-1.471	28.2801
		26.1336 **(Full Blade)**
272	-0.248	
303.5	-0.801	23.9436
335	-1.471	28.2801
		26.1521 **(Full Blade)**

Table 2: IOT Stock Propeller #P104R QA Measurements

CCGA Atlantic Swell Seakeeping Experiments

Offshore Engineering Basin **Jan./Feb. 2005**

Model #IOT651 **Scale 1:4.697**

Name	Units	Range	Sample Rate (Hz)	Device
shaft rps	rps	0-25	50	tachometer
pitch rate	deg./s	50	50	MotionPak I
roll rate	deg./s	75	50	MotionPak I
yaw rate	deg./s	15	50	MotionPak I
heave acceleration	G	+/- 1	50	MotionPak I
sway acceleration	G	+/- 1	50	MotionPak I
surge acceleration	G	+/- 1	50	MotionPak I
rudder angle	deg.	+/- 35	50	potentiometer
heading angle	deg.	0-360	50	QUALISYS
roll angle	deg.	0-35	50	QUALISYS
pitch angle	deg.	0-15	50	QUALISYS
vertical acceleration	m/s^2	0-12	50	linear uni-axial accelerometer
lateral acceleration	m/s^2	0-12	50	linear uni-axial accelerometer
X Displacement	m	0-56	50	QUALISYS
Y Displacement	m	0-26	50	QUALISYS
Z Displacement	m	+/- 1	50	QUALISYS
South East Wave Elevation	m	+/- 1	50	Capacitance Wave Probe
South Center Wave Elevation	m	+/- 1	50	Capacitance Wave Probe
South West Wave Elevation	m	+/- 1	50	Capacitance Wave Probe
North Center Wave Elevation	m	+/- 1	50	Capacitance Wave Probe

NOTE:
1) Model forward speed to be computed from QUALISYS X and Y displacement.
2) MotionPak I data to be used to compute the following 18 channels:
    Roll/Pitch/Yaw Angle/Velocity/Acceleration
    Surge/Sway/Heave Displacement/Velocity/Acceleration
MotionPak motions can be moved to any point on the rigid body and output in either an earth or a body co-ordinate system.
3) Vertical & lateral linear accelerometers to be installed in bow to verify MotionPak data.
4) An RMS error channel was also acquired to monitor QUALISYS signal integrity.
5) A south and west wave board amplitude signal were also acquired to monitor actual wave board activity.
6) All channels to be sampled at 50 Hz, low pass filtered at 10 Hz.

Table 3: List of Signals Measured

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**

Speed (knots)	Heading	File Name	Roll Angle (deg.)	Pitch Angle (deg.)	Yaw Angle (deg.)	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Seq. #	Wave
0	90	SPD0_HDG270A	4.9382	1.8719	23.0000	0.2150	0.3038	0.4198	N/A	MUN WAVE 2
0	90	SPD0_HDG270B	5.2282	1.8619	14.5520	0.2318	0.2976	0.4393	N/A	MUN WAVE 2
0	90	IOT0_HDG270	5.4505	1.9041	12.7740	0.2161	0.3297	0.4652	N/A	IOT WAVE 2
4	205	SPD4_HDG205	2.8565	2.9577	8.8194	0.3439	0.2809	0.9427	1	MUN WAVE 1F
4	210	SPD4_HDG210	2.4712	2.8654	5.3377	0.2988	0.2309	0.9168	3	MUN WAVE 1
4	245	SPD4_HDG245	2.6000	2.3028	6.5478	0.2396	0.2854	0.7874	2	MUN WAVE 2F
4	65	SPD4_HDG65	5.9818	1.4318	3.2007	0.2137	0.3178	0.4362	6	MUN WAVE 2
4	65	IOT4_HDG65	4.2191	1.3631	4.0316	0.2070	0.2899	0.3748	6	IOT WAVE 2
4	25	SPD4_HDG25	1.7111	1.8052	3.7845	0.2910	0.1626	0.2000	7	MUN WAVE 1
8	200	SPD8_HDG200	2.6423	1.5233	4.3895	0.2020	0.2520	0.7854	5	MUN WAVE 3
8	200	IOT8_HDG200	1.3984	1.9101	3.1093	0.2314	0.1751	0.9846	5	IOT WAVE 3
8	210	SPD8_HDG210	1.7518	1.6591	4.1922	0.2129	0.1965	0.8317	4	MUN WAVE 3F
8	75	SPD8_HDG75	2.7863	1.1955	3.8741	0.1567	0.2957	0.7127	10	MUN WAVE 3
8	60	SPD8_HDG60	2.9087	1.0233	3.1725	0.1427	0.2760	0.5792	8	MUN WAVE 3
8	20	SPD8_HDG20	3.7676	1.4413	3.3520	0.2063	0.2009	0.2397	9	MUN WAVE 3

NOTE: All values in table are Standard Deviation values.
All motion data is derived from MotionPak at CG.

Table 4: Summary of Basic Statistics

Summary of Motion Decay Results - CCGA Atlantic Swell Model #IOT651

Fishing Vessel Research Proj. #2017 **Jan. 25, 2005**
Offshore Engineering Basin **Scale: 1:4.697**

Roll Decay Experiments:

Forward Speed (knots FS)	Excitation #	Average Period (s)	Offset (deg.)	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0	1	3.1658	0.8349	0.03863	-0.00179	0.04578
0	2	3.2107	0.7949	0.03678	0.00129	0.03005
0	3	3.2222	0.7812	0.03132	0.00241	0.01957
4	1	3.1749	0.9492	0.10306	0.01869	0.05664
4	2	3.2236	0.8998	0.10929	0.02275	0.03925
4	3	3.2393	0.8211	0.10784	0.01353	0.05775
8	1	3.2047	1.3341	0.14350	-0.00439	0.15259
8	2	3.2505	0.9787	0.15108	0.00139	0.14661
8	3	3.3366	0.9801	0.14144	0.00179	0.13571

NOTE: Forward speed for 8 knot runs was actually 7.2 - 7.4 knots due to insufficient model propulsion power.

Pitch Decay Experiments:

Forward Speed (knots FS)	Excitation #	Period (s)	Offset (deg.)	ND Damping Ratio (gamma)	Damping Time Constant (tau) (s)
0	1	2.8705	2.13487	0.132803	3.44012
0	2	2.8564	2.54539	0.161894	2.80803
0	3	2.8073	2.59907	0.164780	2.71144

NOTE: Pitch decay data for a single cycle/excitation.

Table 5: Summary of Roll and Pitch Decay Results – All Values Full Scale

CCGA ATLANTIC SWELL - MODEL #IOT651

Fishing Vessel Research Proj. #2017 Jan./Feb. 2005

Offshore Engineering Basin

Comparison of QUALISYS & MotionPak motions - example RUN_211

Forward Speed = 4 knots full scale, Run Sequence #6

	Units	Minimum	Maximum	Mean	Std. Dev.	% Diff. - Std. Dev.
MotionPak Roll Angle	deg.	-10.505	14.812	0.019353	4.1024	0.465
QUALISYS Roll Angle	deg.	-9.9456	15.45	0.60751	4.0834	
MotionPak Pitch Angle	deg.	-3.0653	2.5493	0	1.2352	0.065
QUALISYS Pitch Angle	deg.	-3.1957	2.4217	0	1.2360	
MotionPak Heave Displacement	m	-0.91108	0.69891	-0.01522	0.29556	31.477
QUALISYS Z Displacement	m	-0.69511	0.52482	0	0.22480	
MotionPak Yaw Angle	deg.	-4.8811	8.1777	0.26160	3.3097	3.012
QUALISYS Heading Angle	deg.	-5.0114	8.2058	0	3.4125	

NOTE: Data tared where necessary.
Statistics computed for the entire nominal valid portion of RUN_211.

Table 6: Comparison of Example MotionPak and QUALISYS Results - RUN_211

CCGA ATLANTIC SWELL SEAKEEPING EXPERIMENTS

Fishing Vessel Research Proj. 2017 **Jan./Feb. 2005**

Summary of Wave Statistics - North Center Wave Probe **Offshore Engineering Basin**

			Matched Statistics		Test Statistics		% Difference from Match		Run	No. of
Wave #	Direction (deg.)	Wave File Name	H_s (m)	Tpd (s)	H_s (m)	Tpd (s)	H_s (m)	Tpd (s)	Sequence No.	Run Segments
1	25	MUN25_WAVE1_002	1.3758	7.4605	1.3235	7.5353	3.804	1.002	3	13
1	25	MUN25_WAVE1_002	1.3758	7.4605	1.3460	7.6198	2.167	2.135	7	16
1	25F	MUN25F_WAVE1_002	1.4061	8.3099	1.3597	7.9063	3.301	4.856	1	17
2	65	MUN65_WAVE2_005	1.3467	7.0718	1.2782	7.1257	5.084	0.762	6	15
2	65F	MUN65F_WAVE2_002	1.4161	7.9475	1.4314	7.8170	1.078	1.642	2	13
3	25	MUN25_WAVE3_006	1.1753	7.6421	1.1113	7.4273	5.448	2.811	5	26
3	25	MUN25_WAVE3_006	1.1753	7.6421	1.1240	7.2590	4.366	5.012	9	24
3	25F	MUN25F_WAVE3_004	0.9912	7.9544	0.9282	7.4047	6.355	6.910	4	26
3	65	MUN65_WAVE3_006	1.3562	7.6488	1.3464	7.1535	0.722	6.475	10	28
3	65	MUN65_WAVE3_006	1.3562	7.6488	1.3224	7.4470	2.490	2.638	8	25
2	65	IOT65_WAVE2_002	1.3897	7.5528	1.3495	7.4606	2.895	1.221	6	16
3	25	IOT25_WAVE3_003	1.1169	7.5627	1.0732	7.7296	3.912	2.206	5	26

NOTE: Wave direction is relative to south wall of OEB.

H_S - significant wave height - from Zero Crossing Analysis

T_{pd} - period of spectral peak computed using 'Delft Method'

All data presented in full scale units.

Table 7: North Center Wave Probe Statistics – Difference From Wave Match Statistics

CCGA ATLANTIC SWELL SEAKEEPING EXPERIMENTS

Fishing Vessel Research Proj. 2017

Summary of Wave Statistics - North Center Wave Probe

Wave #	Direction (deg.)	Wave File Name	Target H_s (m)	Target Tpd (s)	% Difference from Target H_s (m)	% Difference from Target Tpd (s)	Run Sequence No.	No. of Run Segments
1	25	MUN25_WAVE1_002	1.51	7.42	12.354	1.554	3	13
1	25	MUN25_WAVE1_002	1.51	7.42	10.862	2.693	7	16
1	25F	MUN25F_WAVE1_002	1.51	7.42	9.955	6.554	1	17
2	65	MUN65_WAVE2_005	1.37	7.42	6.698	3.967	6	15
2	65F	MUN65F_WAVE2_002	1.37	7.42	4.480	5.350	2	13
3	25	MUN25_WAVE3_006	1.25	7.42	11.098	0.098	5	26
3	25	MUN25_WAVE3_006	1.25	7.42	10.081	2.169	9	24
3	25F	MUN25F_WAVE3_004	1.25	7.42	25.743	0.206	4	26
3	65	MUN65_WAVE3_006	1.25	7.42	7.713	3.591	10	28
3	65	MUN65_WAVE3_006	1.25	7.42	5.794	0.364	8	25
2	65	IOT65_WAVE2_002	1.37	7.42	1.499	0.547	6	16
3	25	IOT25_WAVE3_003	1.25	7.42	14.143	4.172	5	26

NOTE: Wave direction is relative to south wall of OEB.

H_S - significant wave height - from Zero Crossing Analysis

T_{pd} - period of spectral peak computed using 'Delft Method'

All data presented in full scale units.

Table 8: North Center Wave Probe Statistics – Difference From Wave Target Statistics

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**

Offshore Engineering Basin **Jan. - Feb. 2005**

SUMMARY OF SIGNIFICANT VALUE STATISTICS

MOTSIM Heading (deg.)	FILE NAME	Speed Nominal/Actual (knots full scale)	Heading Angle Nominal/Actual (deg.)	Roll Angle (deg.)	Pitch Angle (deg.)	Yaw Angle (deg.)	Heave Acceleration (m/s^2)	Sway Acceleration (m/s^2)	Surge Acceleration (m/s^2)	Heave Displacement (m)
90	IOT0_HDG270	0 / drift	270 / 267.81	10.901	3.808	25.548	0.930	0.659	0.432	0.727
90	SPD0_HDG270A	0 / drift	270 / 264.82	9.876	3.744	46.000	0.840	0.608	0.430	0.705
90	SPD0_HDG270B	0 / drift	270 / 267.17	10.456	3.724	29.104	0.879	0.595	0.464	0.716
-150	SPD4_HDG210	4 / 3.9479	210 / 211.33	4.942	5.731	10.675	1.834	0.462	0.598	0.766
25	SPD4_HDG25	4 / 4.2685	25 / 24.382	3.422	3.610	7.569	0.400	0.325	0.582	0.658
65	SPD4_HDG65	4 / 4.1895	65 / 65.217	11.964	2.864	6.401	0.872	0.636	0.427	0.715
115	SPD4_HDG115	4 / 4.188	115 / 113.42	5.200	4.606	13.096	1.575	0.571	0.479	0.777
155	SPD4_HDG155	4 / 3.9304	155 / 155.0	5.713	5.915	17.639	1.885	0.562	0.688	0.813
-160	SPD8_HDG200	8 / 7.4353	200 / 198.14	5.285	3.047	8.779	1.571	0.504	0.404	0.628
20	SPD8_HDG20	8 / 7.4896	20 / 19.671	7.535	2.883	6.704	0.479	0.402	0.413	0.554
60	SPD8_HDG60	8 / 7.4773	60 / 59.298	5.817	2.047	6.345	1.158	0.552	0.285	0.613
75	SPD8_HDG75	8 / 7.4221	75 / 77.26	5.573	2.391	7.748	1.425	0.591	0.313	0.656
150	SPD8_HDG150	8 / 7.436	150 / 151.11	3.504	3.318	8.384	1.663	0.393	0.426	0.634
65	IOT4_HDG65	4 / 4.2554	65 / 65.402	8.438	2.726	8.063	0.750	0.580	0.414	0.689
-160	IOT8_HDG200	8 / 7.4259	200 / 198.92	2.797	3.820	6.219	1.969	0.350	0.463	0.668

NOTE: - Heading Angle is with respect to the incident waves.
- All values are significant values defined as 2 * Standard Deviation with the exception of speed and heading angle which are mean values.
- Zero speed runs are drifting at a low lateral speed & are free to yaw.

Table 9: Summary of Physical Model Data

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017

SUMMARY OF STATISTICS **MOTSIM Simulation Results**

MOTSIM Hdg (deg.)	Speed (kts)	Heading	Roll Angle (deg.)	Pitch Angle (deg.)	Yaw Angle (deg.)	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Heave Displ. (m)
-150	4	Head	10.804	4.436	31.839	0.586	1.28	1.447	0.960
25	4	Following	7.211	4.329	16.482	0.454	0.748	1.332	0.828
65	4	Quartering	10.173	3.709	23.835	0.517	1.939	1.206	0.715
115	4	Beam	9.961	3.997	23.109	0.523	1.732	1.341	0.916
155	4	Bow	7.235	4.396	24.517	0.461	0.549	1.299	0.933
-160	8	Head	6.673	4.180	29.903	0.520	0.656	1.145	0.621
20	8	Following	5.796	3.348	33.113	0.341	0.586	1.077	0.612
60	8	Quartering	5.962	3.236	35.808	0.435	0.920	1.171	0.652
75	8	Beam	6.633	3.422	37.770	0.423	1.071	1.199	0.640
150	8	Bow	4.970	3.741	20.579	0.350	0.541	1.144	0.652

NOTE: The above values are Significant values (2 * Standard Deviation) of the particular motion.

Table 10: Summary of MOTSIM Simulation Results

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017
October 4, 2003

SUMMARY OF STATISTICS **FULL SCALE TRIAL RESULTS**

MOTSIM Hdg (deg.)	Speed (kts)	Heading	Roll Angle (deg)	Pitch Angle (deg)	Yaw Angle (deg)	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Heave Displ. (m)
	0	Beam Drift	10.985	3.940	28.108	0.507	0.570	0.912	0.740
-150	4	Head	10.778	4.933	41.766	0.670	0.642	1.440	0.928
25	4	Following	7.702	5.452	33.458	0.654	0.548	1.827	0.826
65	4	Quartering	7.938	4.465	49.262	0.562	0.624	1.617	0.762
115	4	Beam	9.338	3.991	42.280	0.488	0.764	1.627	0.856
155	4	Bow	10.514	4.041	36.598	0.523	0.715	1.438	0.832
-160	8	Head	6.204	3.300	29.792	0.479	0.642	1.650	0.758
20	8	Following	4.948	3.320	13.208	0.488	0.474	1.546	0.672
60	8	Quartering	5.166	2.842	31.558	0.440	0.654	1.275	0.710
75	8	Beam	6.589	2.714	22.862	0.385	0.646	1.369	0.762
150	8	Bow	6.197	2.838	33.984	0.440	0.687	1.422	0.734

NOTE:
The above values are Significant values (2 * Standard Deviation) of the particular motion.
The accelerations were measured for the center of gravity of the vessel by MotionPak software.

Table 11: Summary of Full Scale Trial Data

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**

Speed (knots)	Heading Angle	Heading	Model Scale Yaw Angle (deg.)	Model Scale Rudder Angle (deg.)	Full Scale Yaw Angle (deg.)	Full Scale Rudder Angle (deg.)
4	-150	Head	5.338	2.524	20.883	7.621
4	25	Following	3.785	2.186	16.729	5.009
4	65	Quartering	3.201	1.725	24.631	5.375
4	115	Beam	6.548	2.067	21.140	5.750
4	155	Bow	8.819	4.024	18.299	5.376
8	-160	Head	4.390	1.005	14.896	2.023
8	20	Following	3.352	1.303	6.604	1.689
8	60	Quartering	3.173	1.275	15.779	2.356
8	75	Beam	3.874	1.205	11.431	1.807
8	150	Bow	4.192	1.075	16.992	2.101

NOTE: All values in table are Standard Deviation values.

Table 12: Listing of Full Scale and Model Scale Yaw/Rudder Angle

Summary of Wave Statistics Collected Using MUN Directional Wave Buoy

CCGA Atlantic Swell **Proj. 2017**
October 4, 2003

NF Time	Sig. Wave Height (m)	Dominant Wave Freq. (Hz)	Average Wave Freq. (Hz)	Dominant Wave Period (s)	Average Wave Period (s)	Dominant Wave Dir. (deg. mag.)	Average Wave Dir. (deg. mag.)	Dominant Wave Dir. (deg. TRUE)	Average Wave Dir. (deg. TRUE)
0:00	2.39	0.13	0.16	7.42	6.29	176.6	-177.9	155.5	-199
2:00	2.07	0.12	0.16	8.06	6.35	191.7	-171.2	170.6	-192.3
4:00	1.85	0.15	0.17	6.87	6.05	175.1	-165.4	154	-186.5
6:00	1.8	0.15	0.17	6.87	6.06	169.5	-155.9	148.4	-177
7:30	1.63	0.12	0.17	8.06	5.79	231.2	-144.0	210.1	-165.1
8:00	1.51	0.13	0.18	7.42	5.68	183.6	-171.7	162.5	-192.8
8:30	1.56	0.12	0.16	8.06	6.09	239.3	-155.6	218.2	-176.7
9:00	1.48	0.16	0.17	6.4	5.78	151.7	179.9	130.6	158.8
9:30	1.37	0.13	0.17	7.42	5.79	220.8	-143.5	199.7	-164.6
10:00	1.38	0.13	0.16	7.42	6.11	208.9	-152.1	187.8	-173.2

NOTE: The magnetic deviation during the trials time frame was 21.1 degrees West

Table 13: Summary of Full Scale Wave Buoy Data

FIGURES

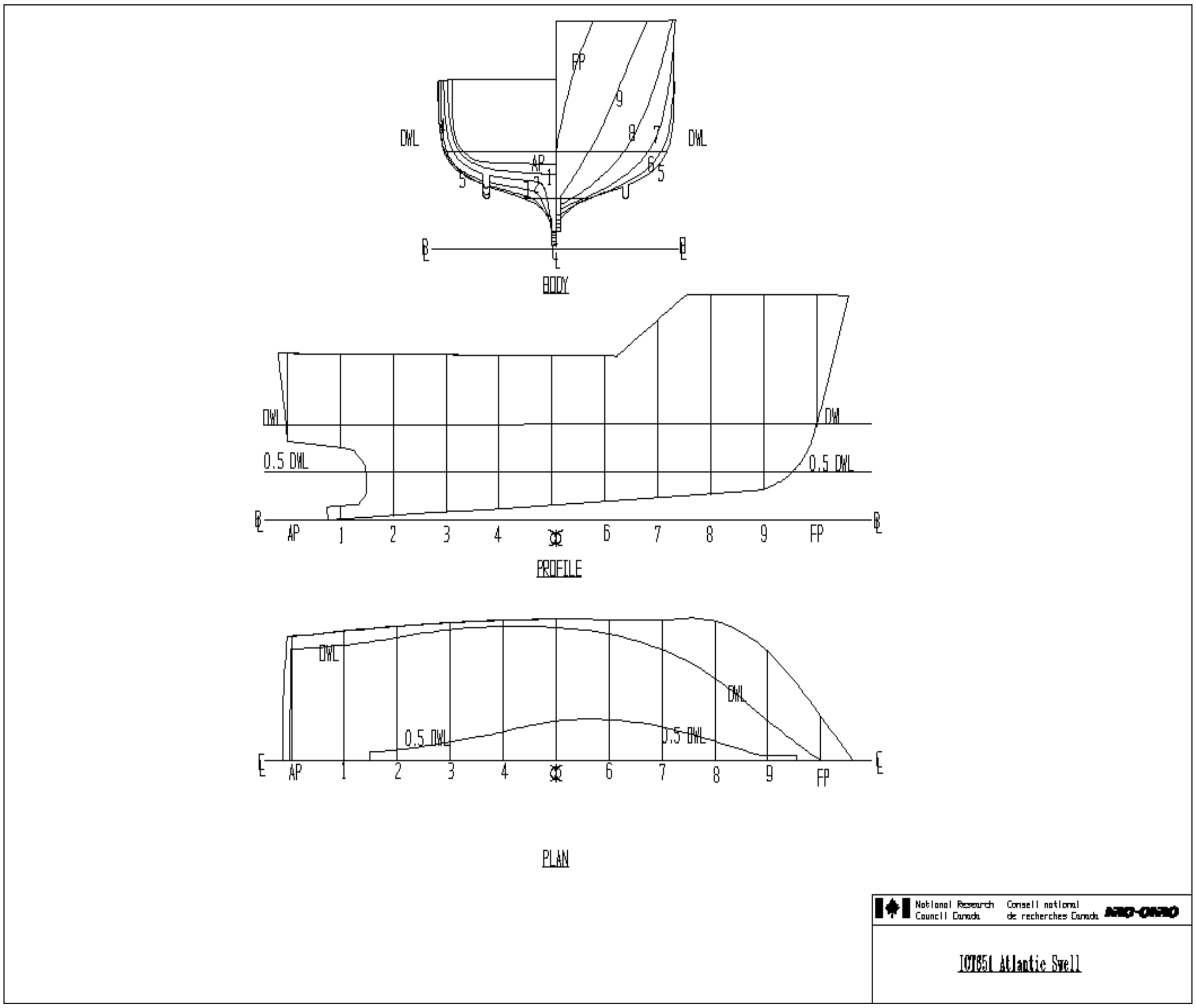


Figure 1: CCGA ATLANTIC SWELL – Model #IOT651

Figure 2: CCGA ATLANTIC SWELL – Model #IOT651

Figure 3: CCGA ATLANTIC SWELL – Model #IOT651 - Propeller #P104R

Figure 4: CCGA ATLANTIC SWELL – Model #IOT651

Figure 5: Model IOT651 – Fully Outfit Excluding Main Deck Hatch

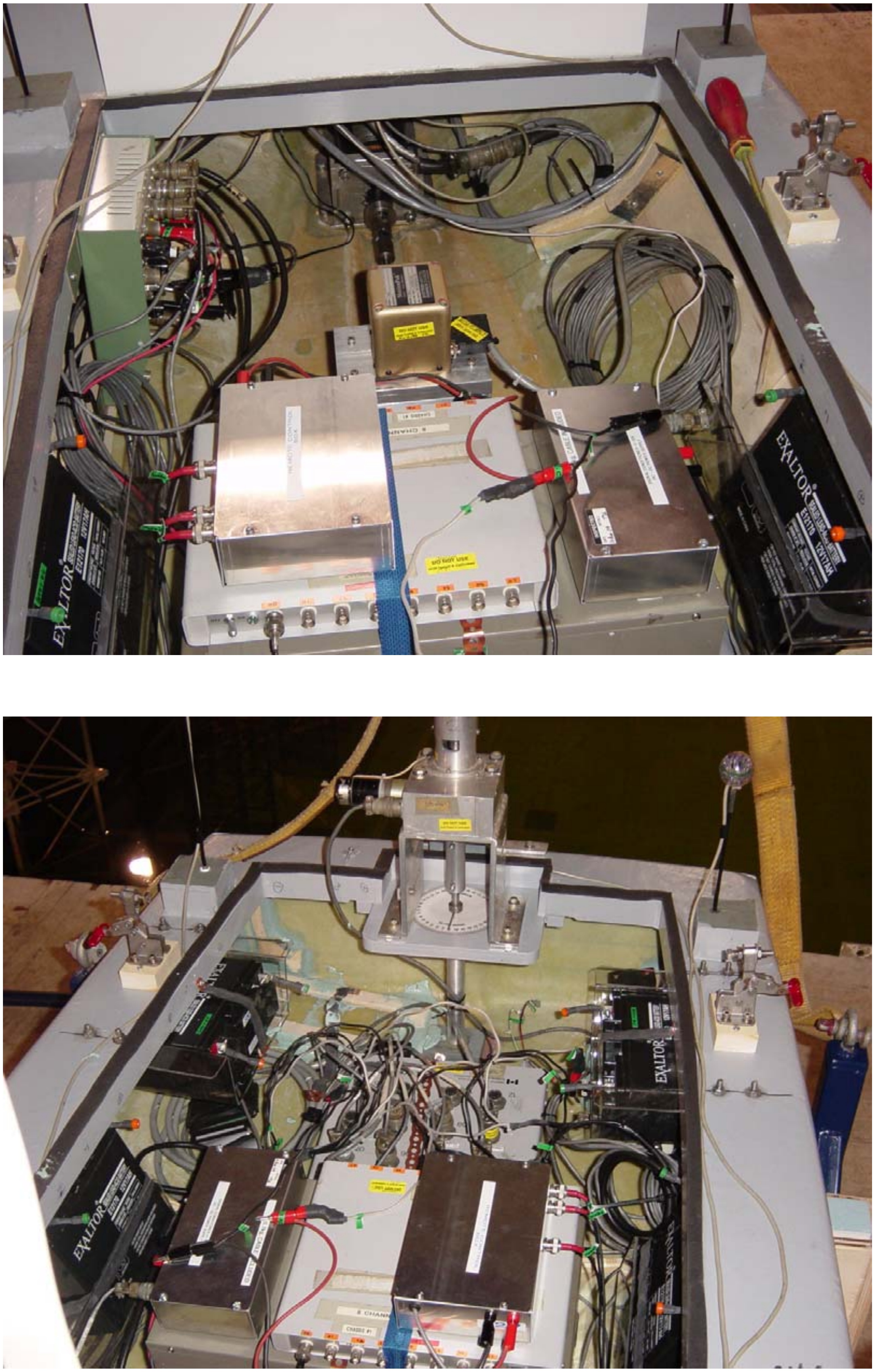


Figure 6: Model IOT651 Internal Outfit Layout

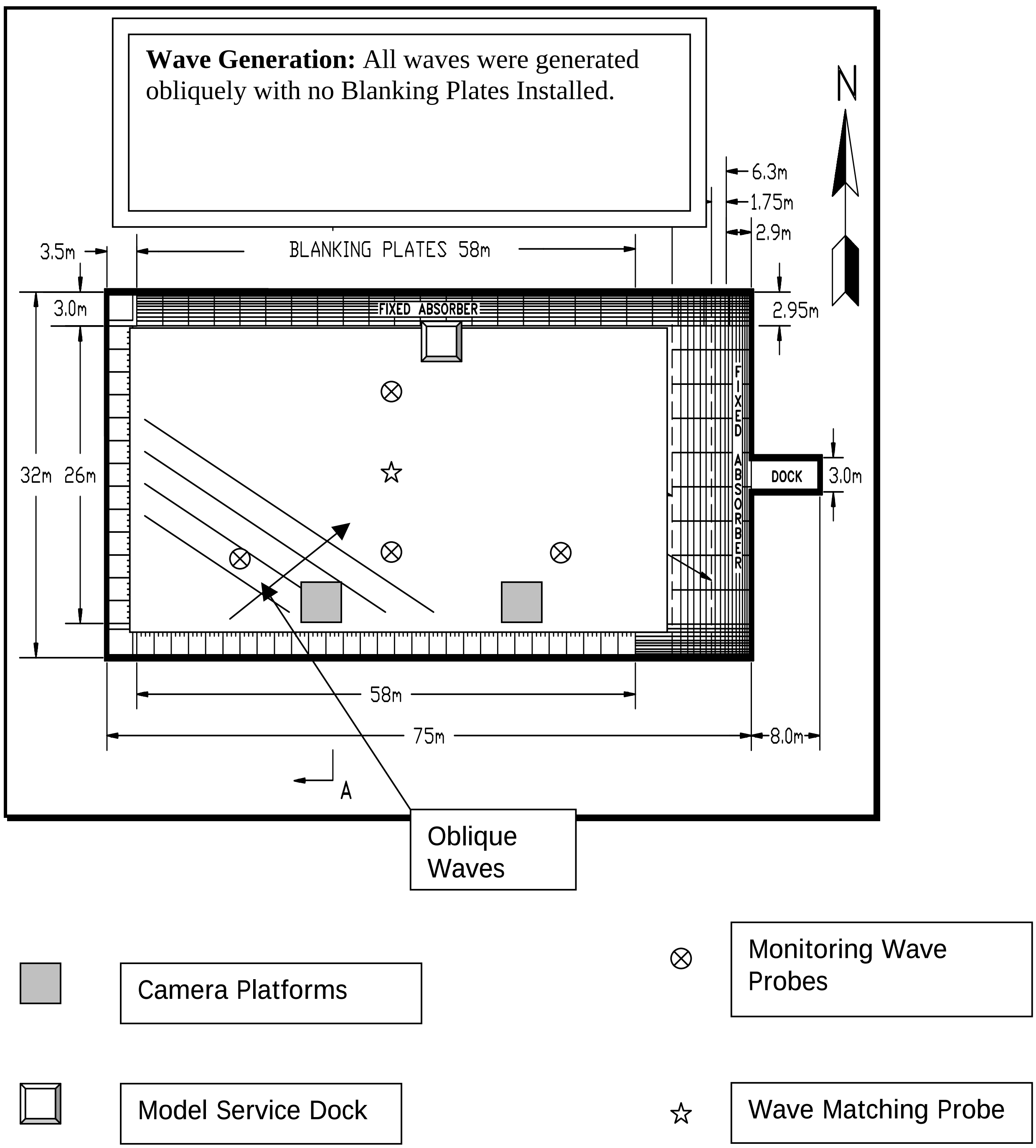


Figure 7: OEB Layout

Figure 8: Model IOT651 Constrained in Launch Frame

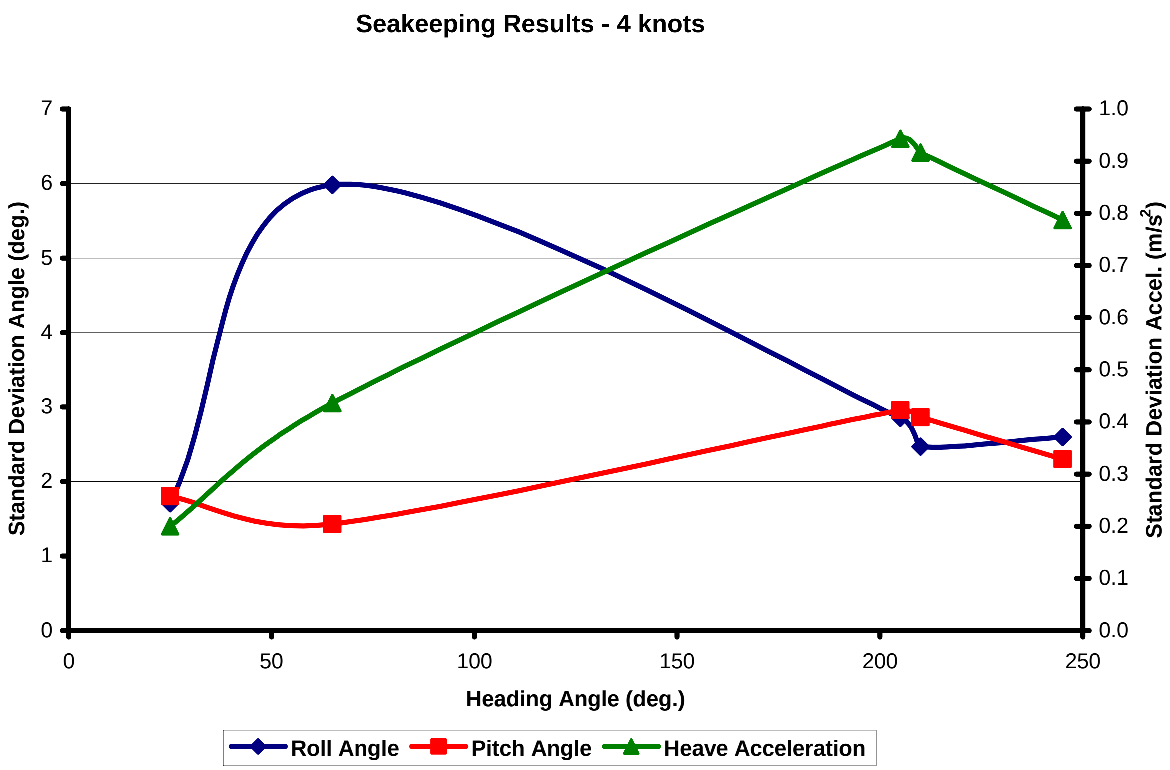


Figure 9: Basic Seakeeping Results – 4 knots

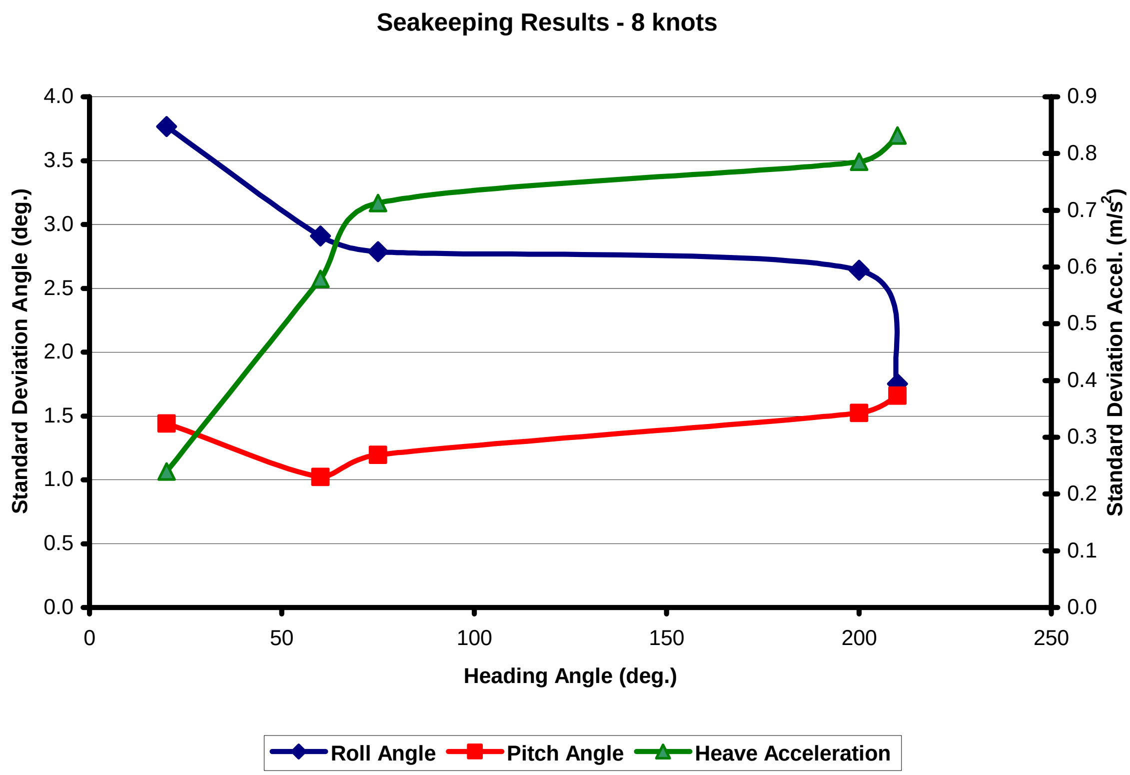


Figure 10: Basic Seakeeping Results - 8 knots

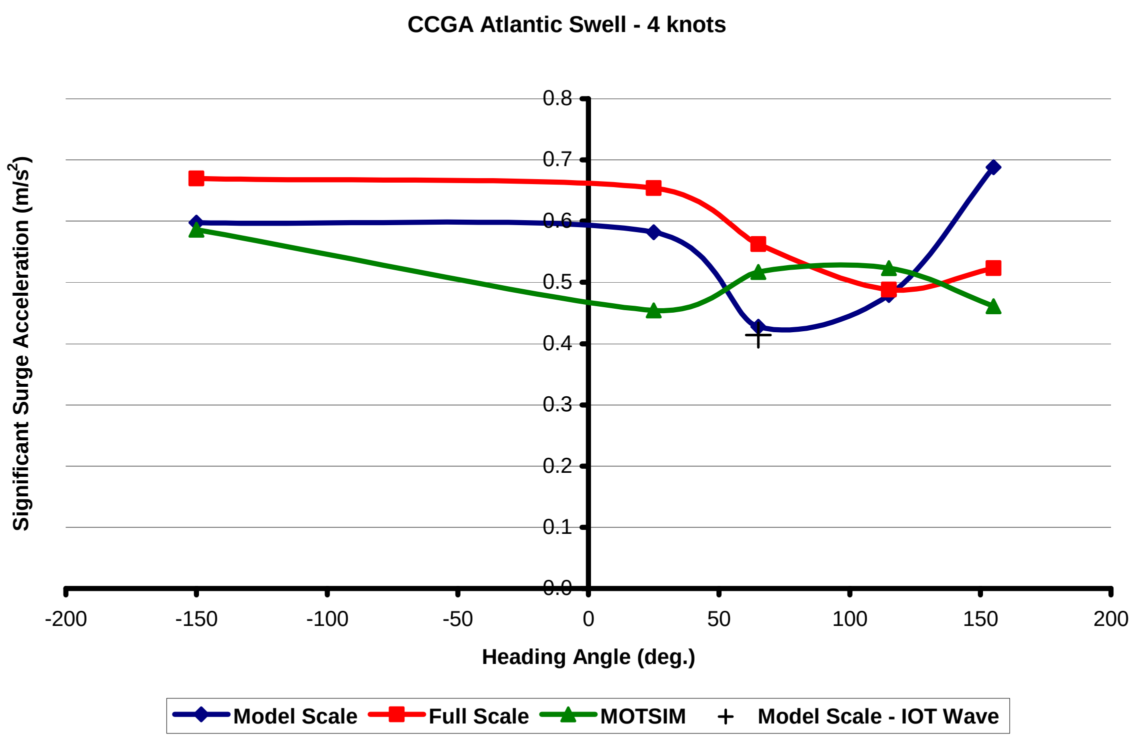


Figure 11: Significant Surge Acceleration vs. Heading Angle – 4 knots

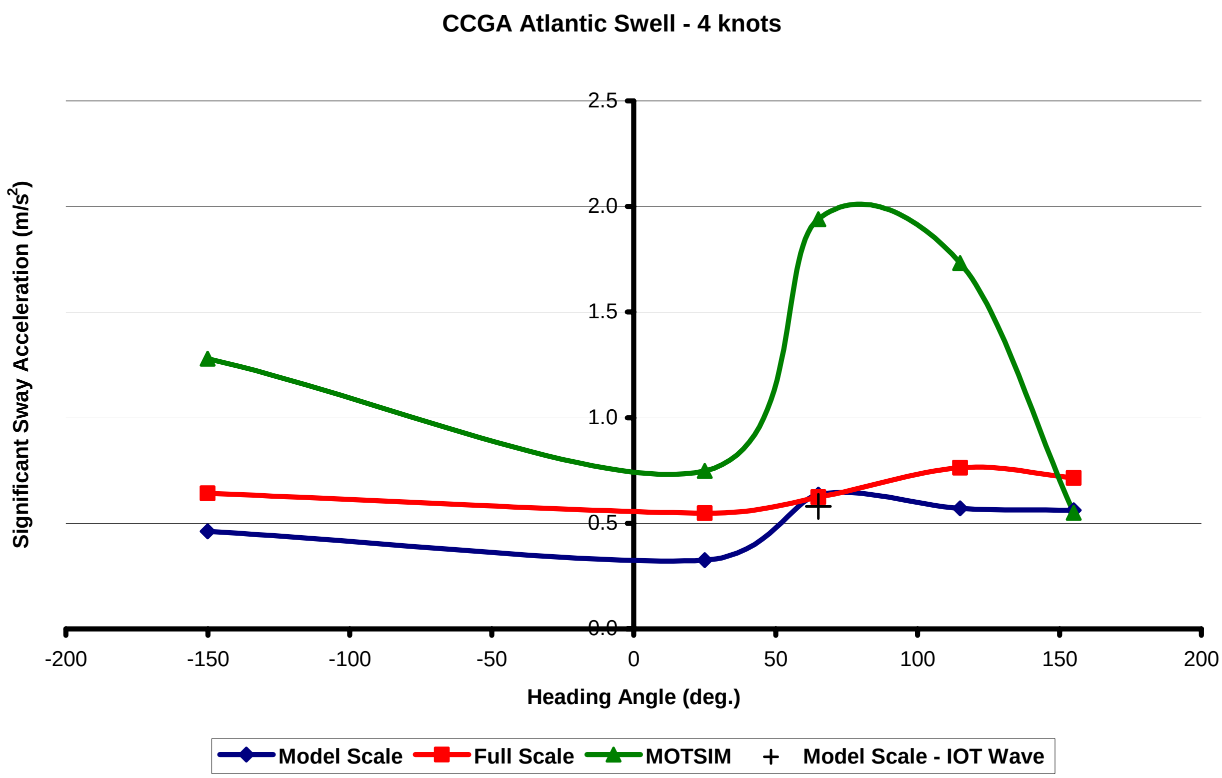


Figure 12: Significant Sway Acceleration vs. Heading Angle – 4 knots

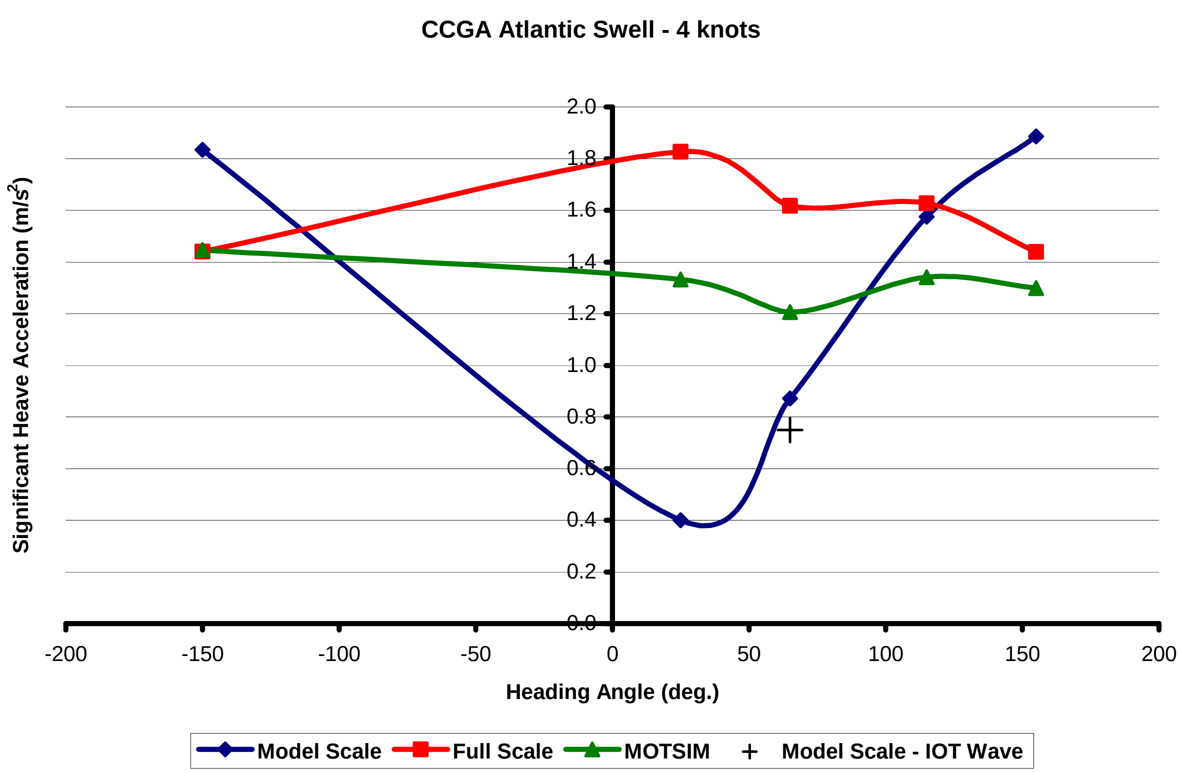


Figure 13: Significant Heave Acceleration vs. Heading Angle – 4 knots

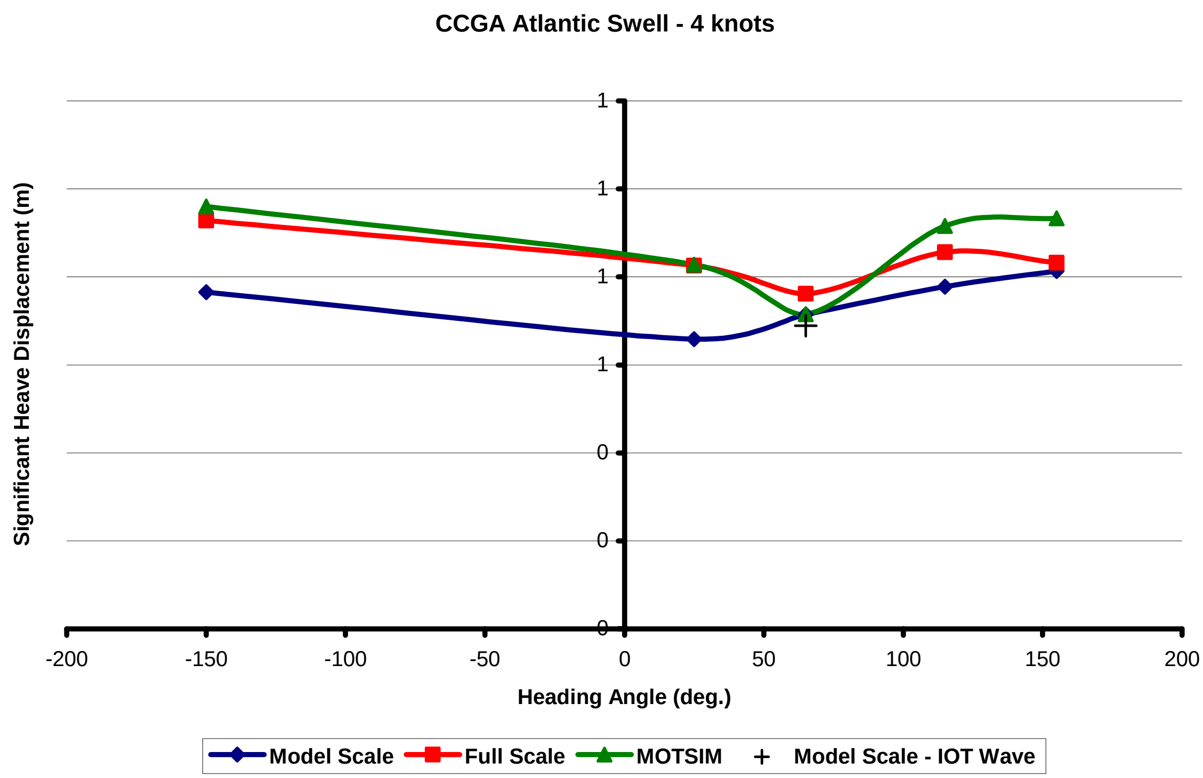


Figure 14: Significant Heave Displacement vs. Heading Angle – 4 knots

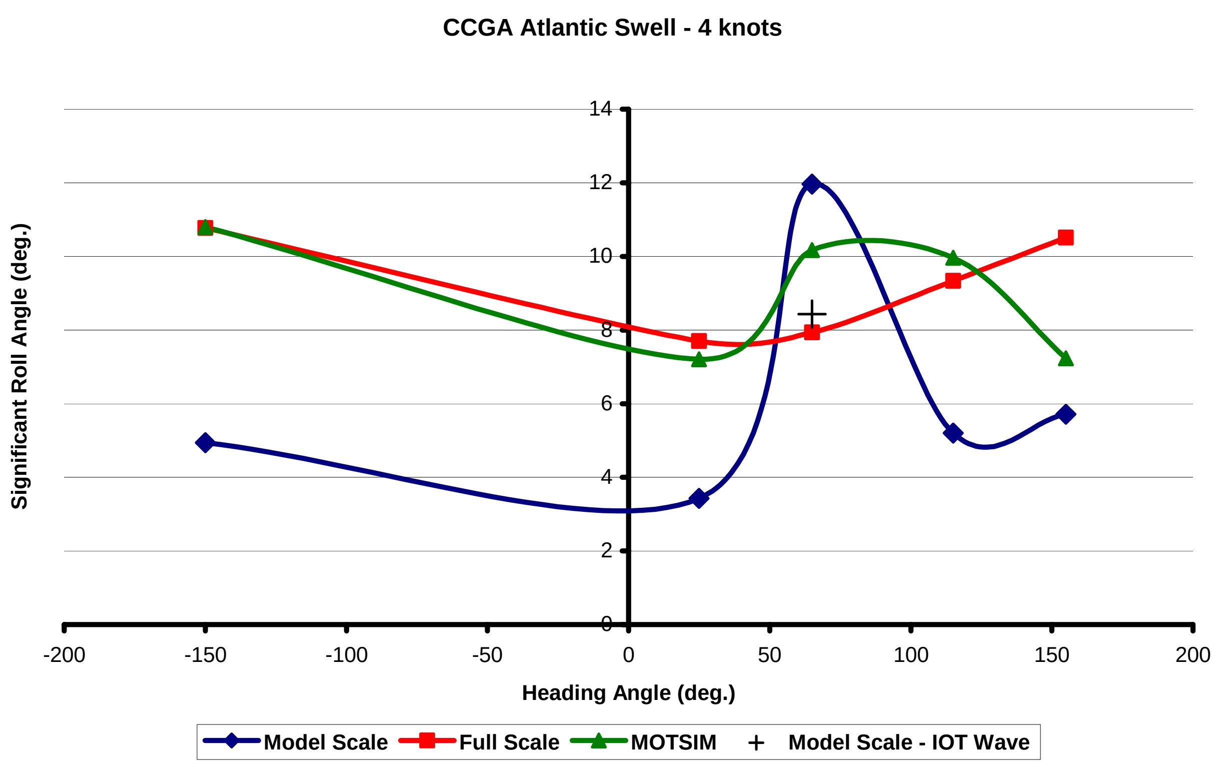


Figure 15: Significant Roll Angle vs. Heading Angle – 4 knots

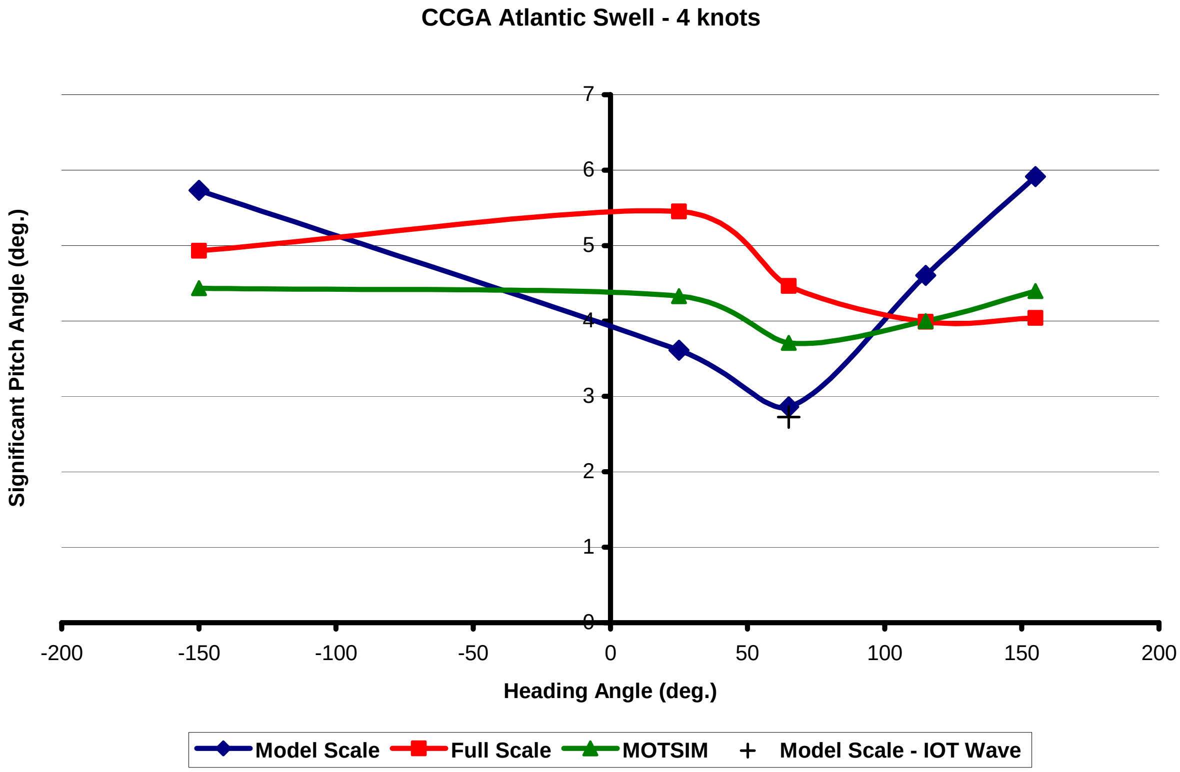


Figure 16: Significant Pitch Angle vs. Heading Angle – 4 knots

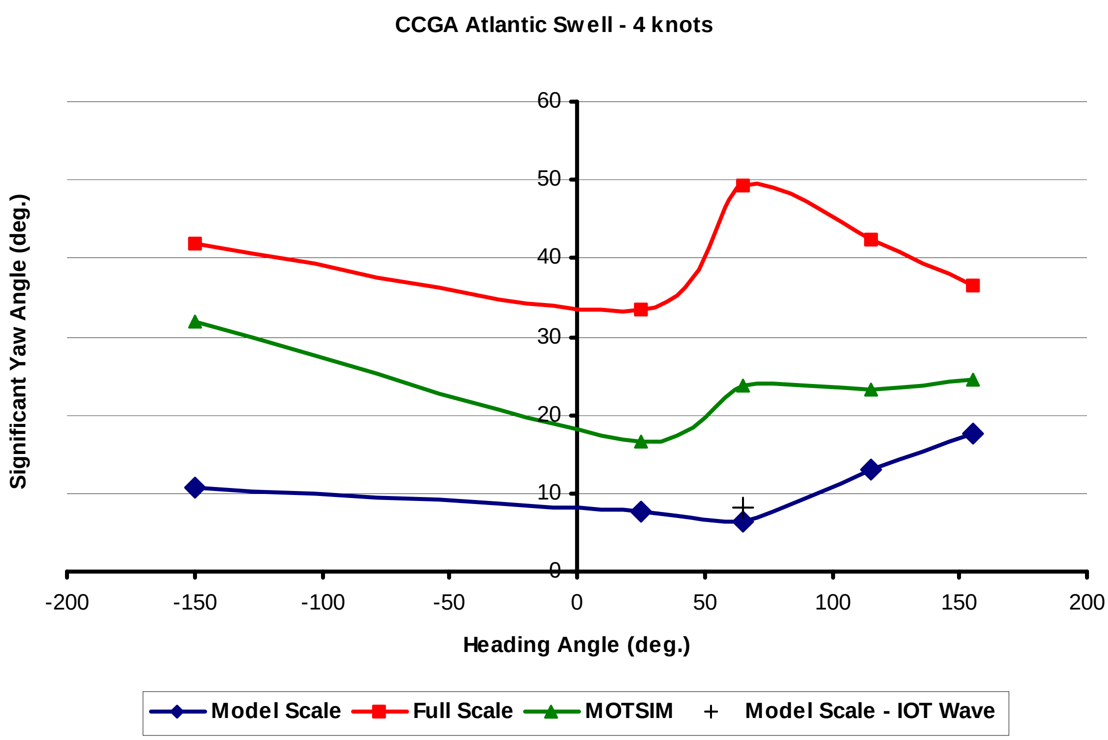


Figure 17: Significant Yaw Angle vs. Heading Angle – 4 knots

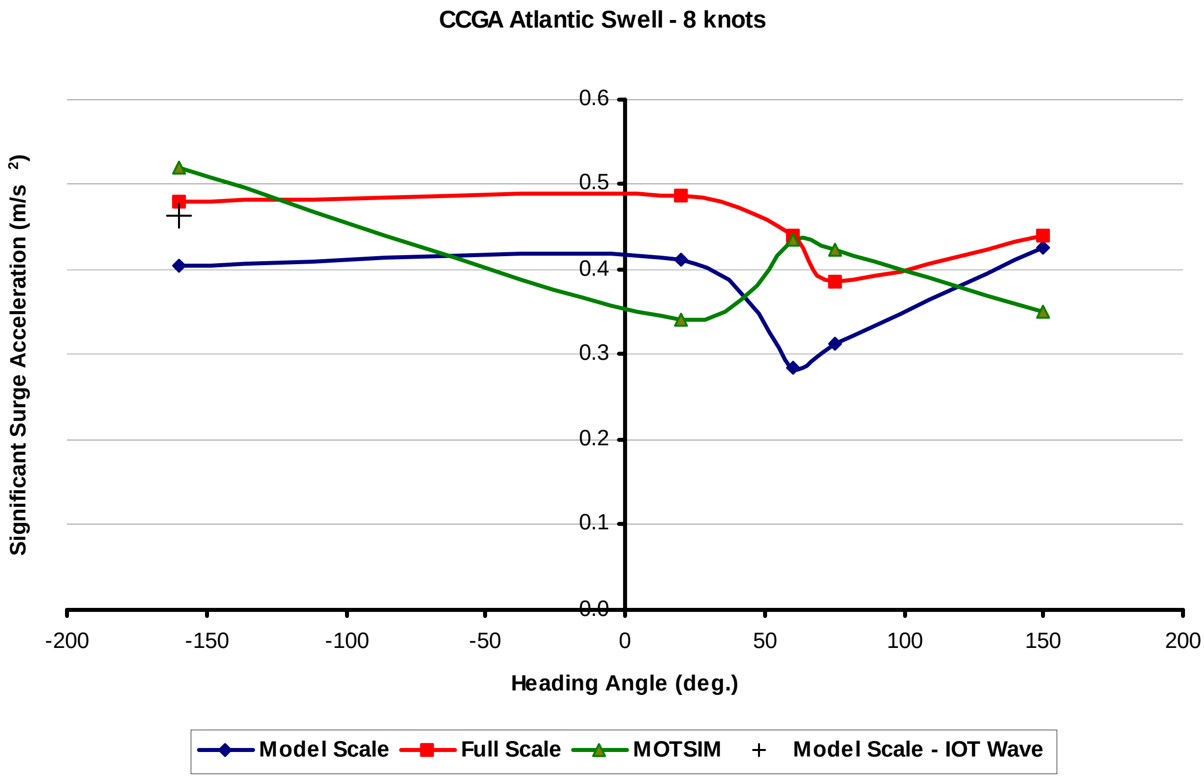


Figure 18: Significant Surge Acceleration vs. Heading Angle – 8 knots

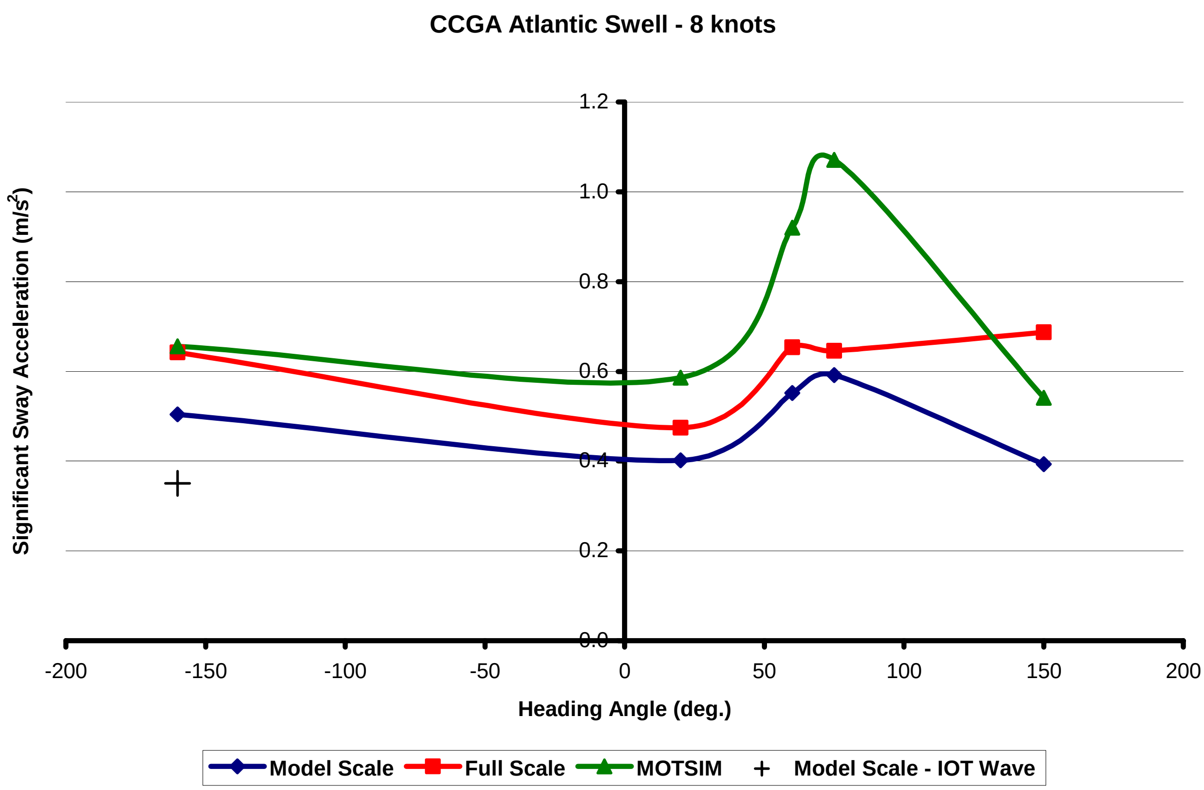


Figure 19: Significant Sway Acceleration vs. Heading Angle – 8 knots

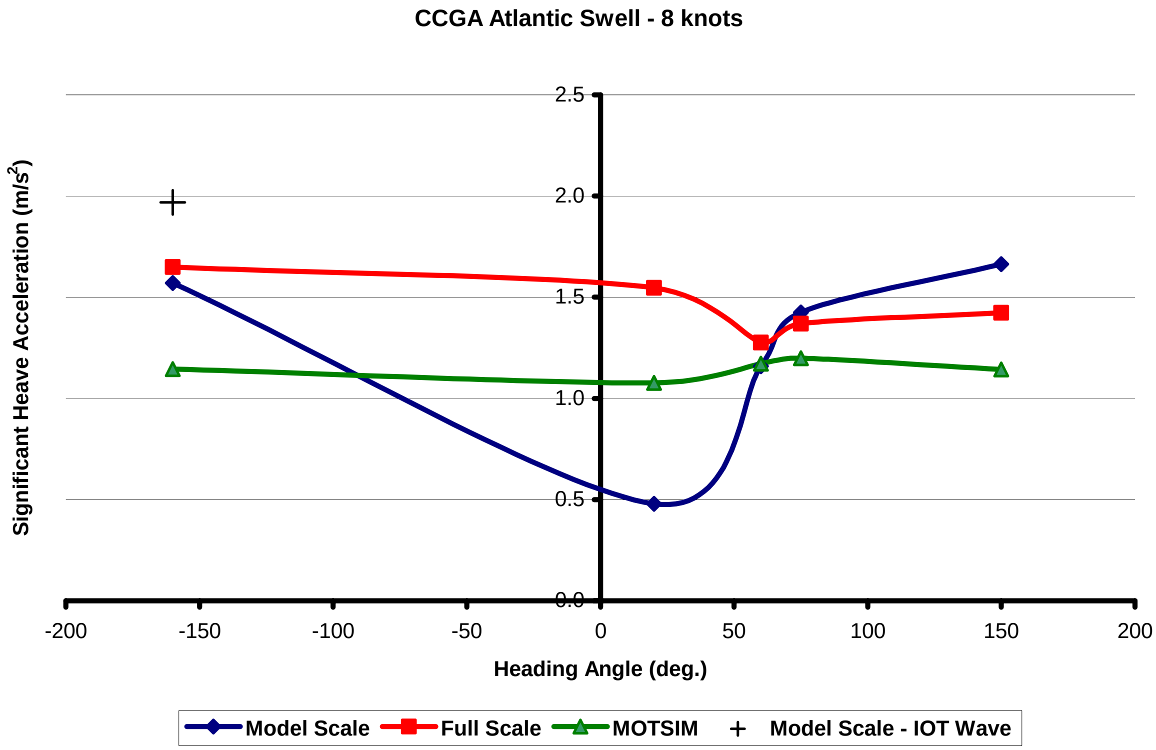


Figure 20: Significant Heave Acceleration vs. Heading Angle – 8 knots

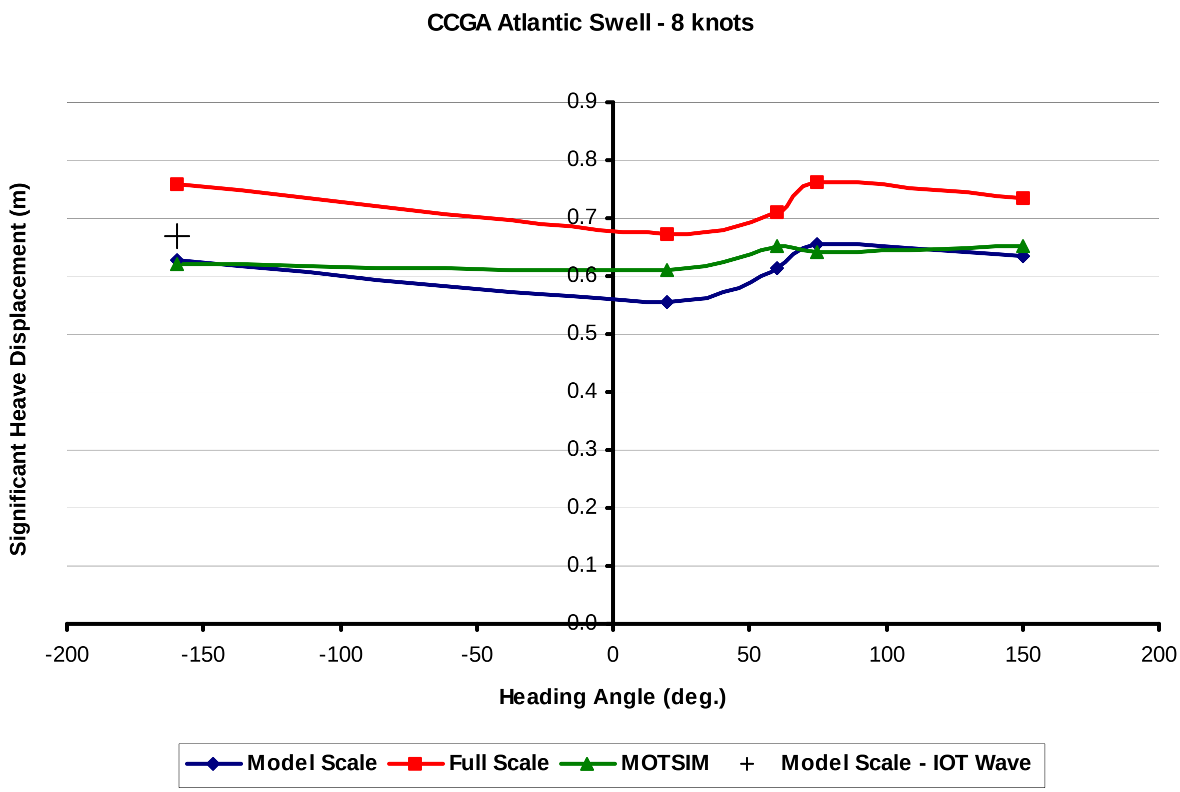


Figure 21: Significant Heave Displacement vs. Heading Angle – 8 knots

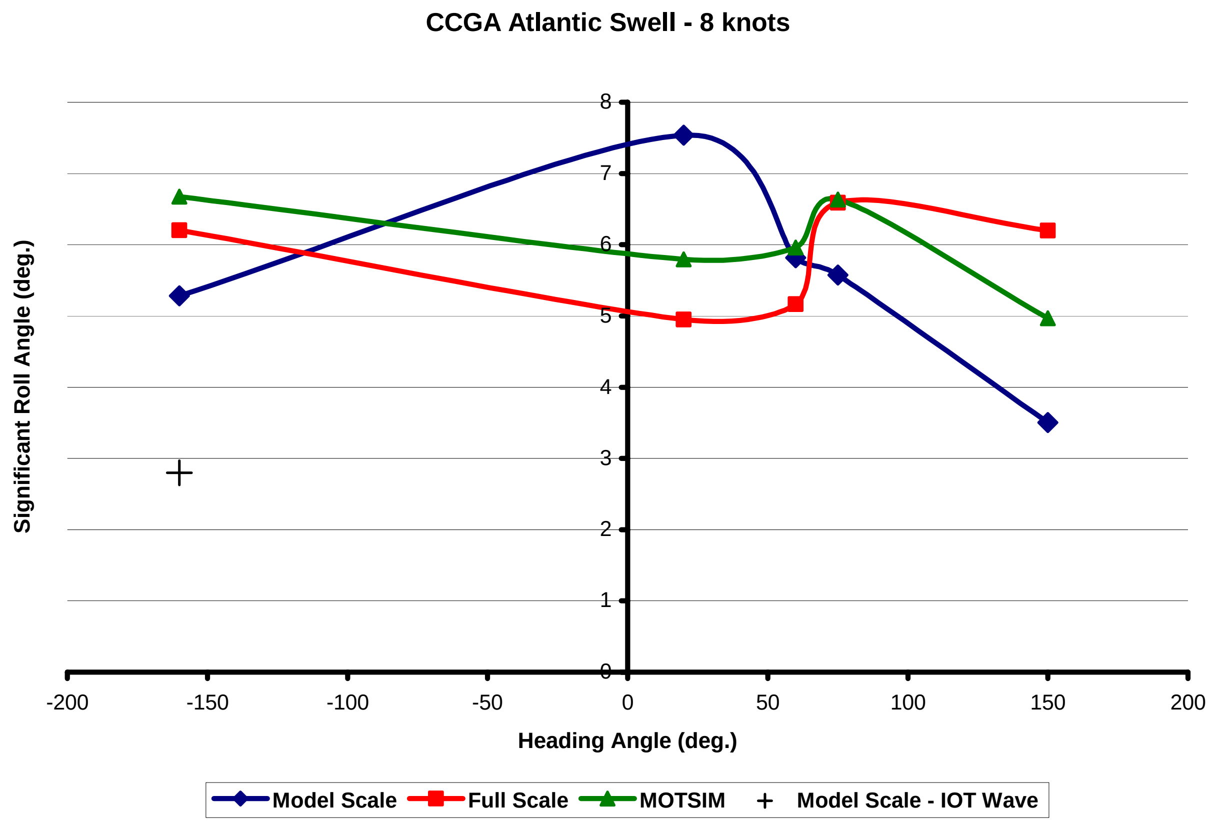


Figure 22: Significant Roll Angle vs. Heading Angle – 8 knots

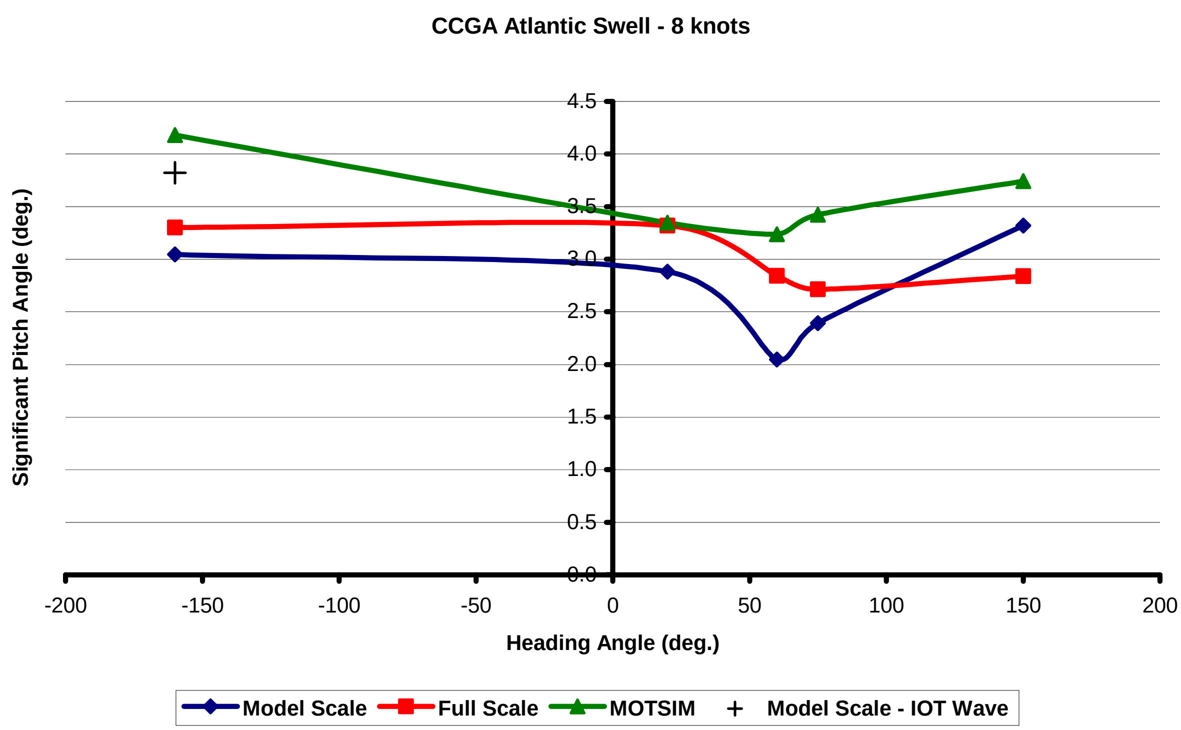


Figure 23: Significant Pitch Angle vs. Heading Angle – 8 knots

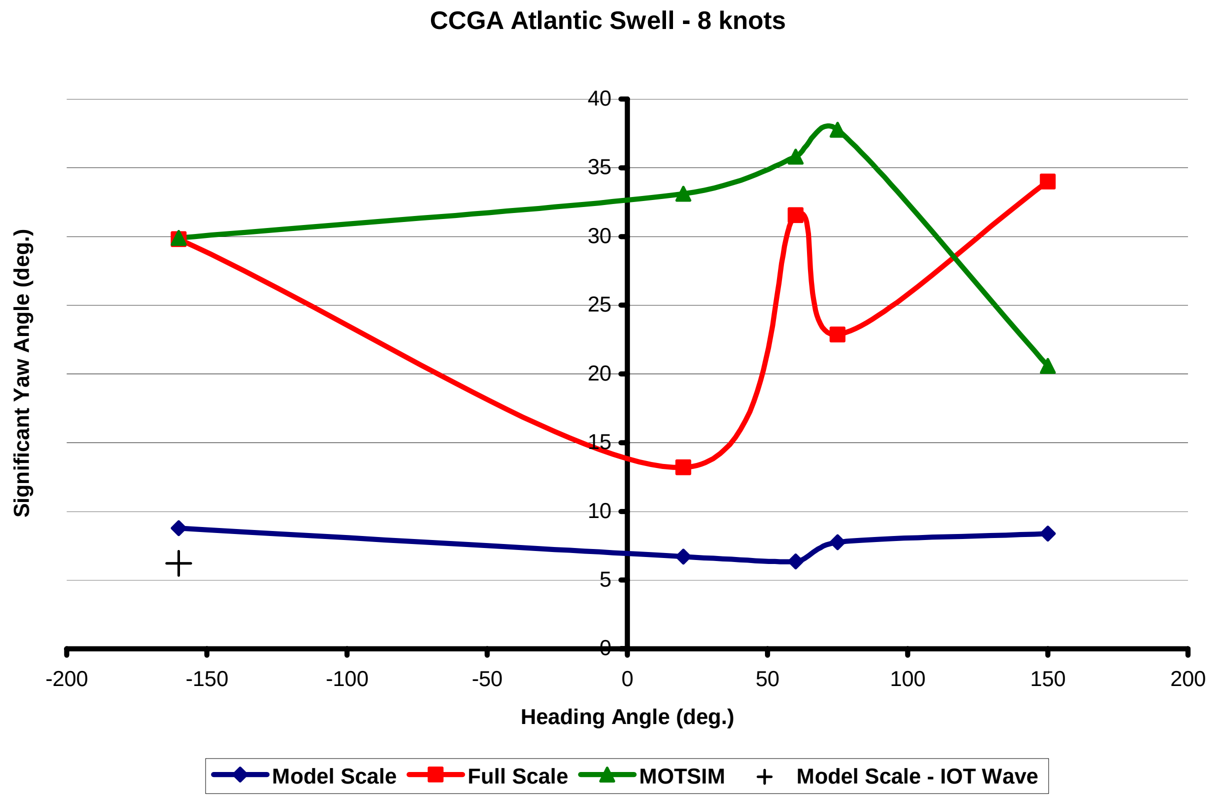


Figure 24: Significant Yaw Angle vs. Heading Angle – 8 knots

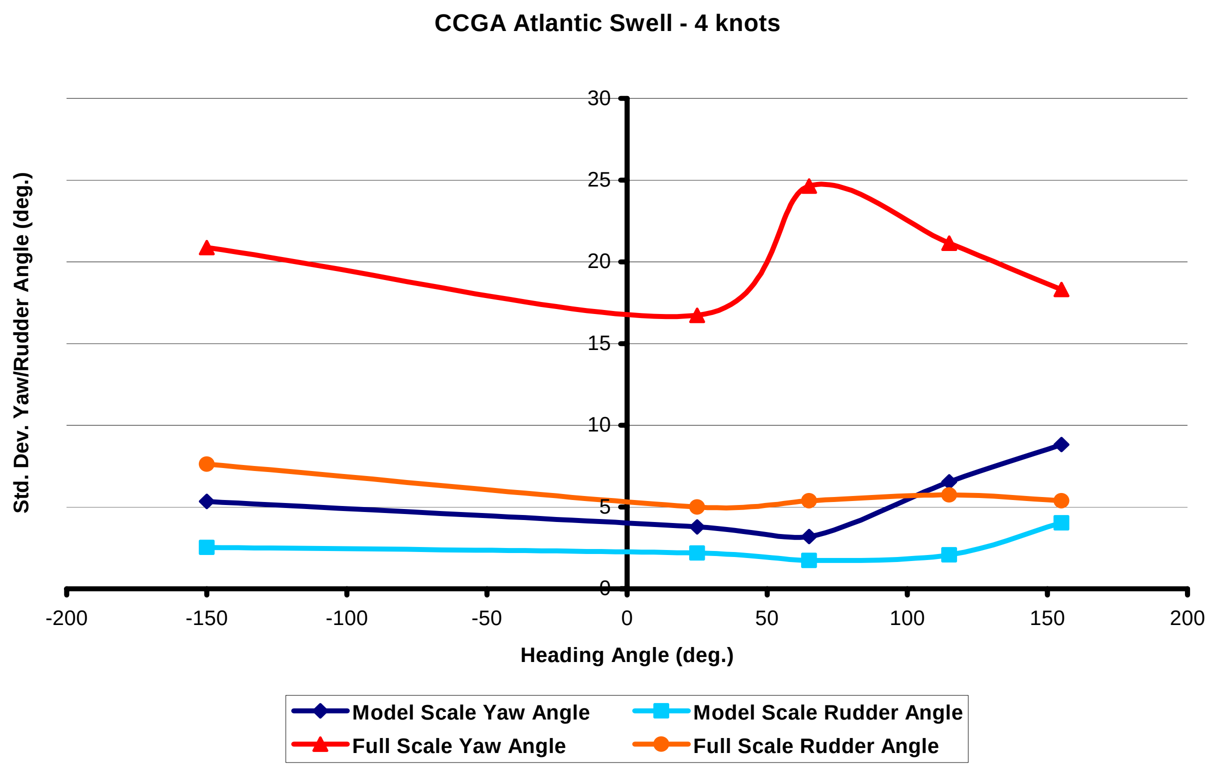


Figure 25: Std. Dev. Yaw/Rudder Angle vs. Heading Angle – 4 knots

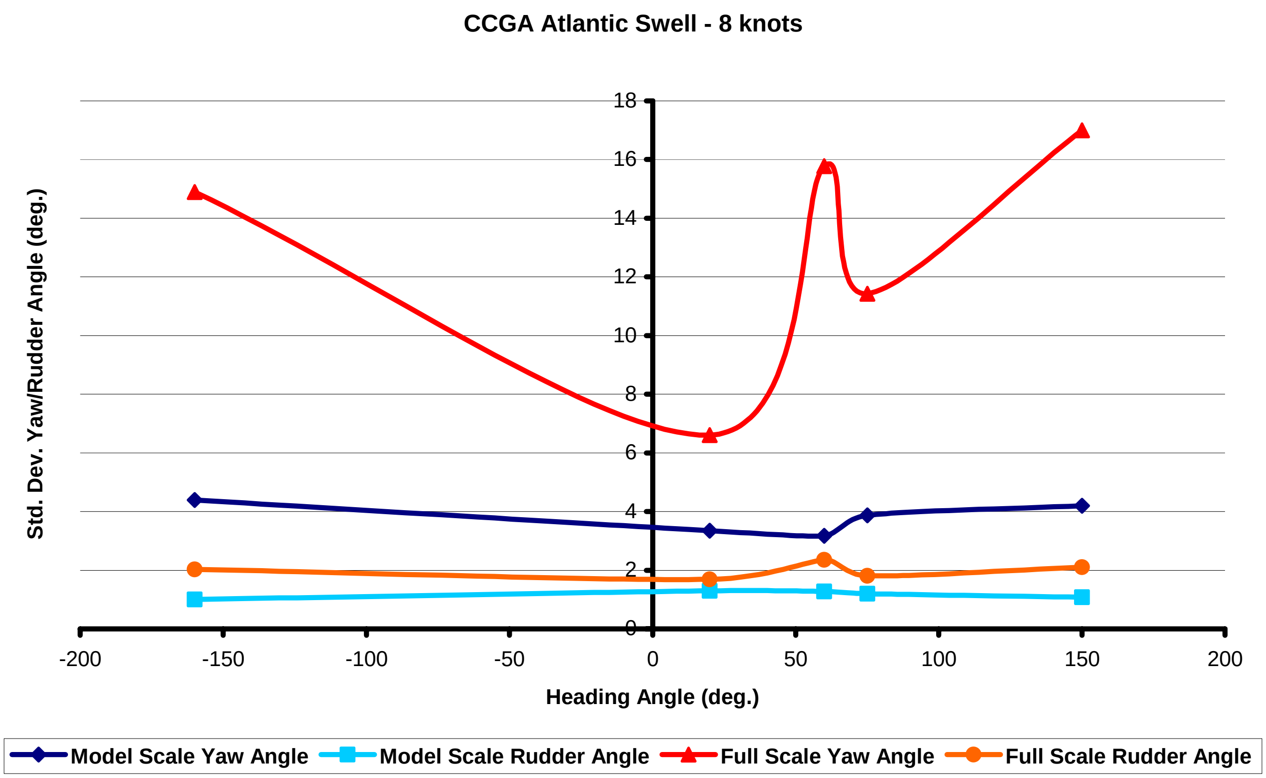


Figure 26: Std. Dev. Yaw/Rudder Angle vs. Heading Angle – 8 knots

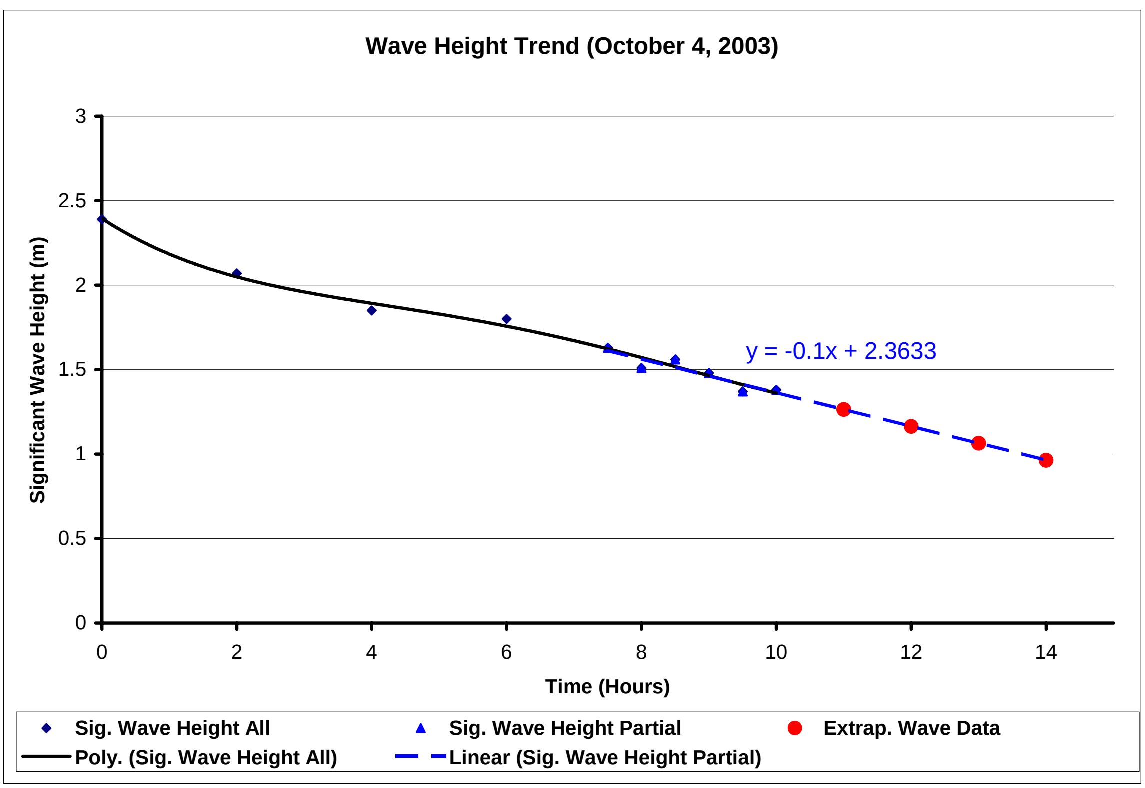


Figure 27: Full Scale Wave Trend Data

Figure 28: CCGA Atlantic Swell on Dock

APPENDIX A: MODEL SWING AND INCLINING RESULTS

CONSTANTS

Model:	IOT651		
Description:	CCGA Atlantic Swell		
Condition:	Lightship	Frame used:	Red Square Alum. Frame
Date:	December 2004	Frame code:	
Model Length:	2.267 m		
Mass of model:	151.700 kg	**Frame Constants Used:**	
Model Beam	0.92676 m	G0B0t (Nm)	235.014
Supports (if not used enter 0.0 for mass):		G0b0l (Nm)	235.130
Mass:	2.7 kg	l1 (m)	0.750
Length:	2.438 m	l2 (m)	0.750
Width	0.609 m	a (m)	0.188
Thickness:	0.0508 m	d (m)	1.197
		J0t (kg-m^2)	82.864
INCLINOMETER		J0l(kg-m^2)	83.045
Mass:	0 kg		
Height above KE	0 m	**Frame Constants Corrected for Support**	
		G0B0t (Nm)	266.037
		G0b0l (Nm)	266.153
INCLINING MASS:	11.4 kg	J0t (kg-m^2)	86.654
		J0l (kg-m^2)	88.069
		d (m)	1.146

Pitch Gyradius Only

Inclining Angles (degrees)			Inclining Angles (degrees)		
PITCH BOW DOWN		Theta (deg)	***PITCH BOW UP***		Theta (deg)
Initial	0.4100		Initial	0.4100	
Weight Fwd 1	4.0700	3.6600	Weight Aft 1	-3.2600	3.6700
Initial	0.4100	3.6600	Initial	0.4100	3.6700
Weight Fwd 2	4.0700	3.6600	Weight Aft 2	-3.2600	3.6700
Initial	0.4100	3.6600	Initial	0.4100	3.6700
Theta (mean)		3.6600	Theta (mean)		3.6700

Theta (mean) for bow up and bow down= 3.665

	PITCH
TRIMMING MASS (kg)	0
DISTANCE FROM KE (X) (m, + fwd)	0
DISTANCE FROM KE (Y) (m, + stbd)	0
DISTANCE FROM KE (Z) (m, + down)	0
Correction to Inertia of System (kg-m^2):	0
Restoring Moment of System (G1b1) (Nm):	1330.07
Restoring Moment of Frame (G0b0) (Nm):	235.13
Restoring Moment of Inclinometer (Gibi) (Nm):	0.00
Restoring Moment of Model (Gb) (Nm):	1094.94
CG of Model and Trim Weight from KE (m):	0.736
VCG of Model and Trim Weight from keel (m):	0.410
VCG of Model from keel (m):	0.4104

Inertia of model

PITCH IN AIR		
Cycles	Time (sec)	Period (sec)
10	25.53	2.553
10	25.46	2.546
10	25.51	2.551
	MEAN	**2.550**

	PITCH
Inertia of Entire System about KE (kg-m^2)	219.08
Inertia of Frame about KE (kg-m^2)	83.05
Inertia of Model about KE (kg-m^2)	136.03
Parallel Axis Correction (kg-m^2)	82.12
Inertia of Model about own CG (kg-m^2)	53.91
Radius of Gyration (m)	0.596
Radius of Gyration/Length	**0.263**

Roll Gyradius Only

INCLINING MASS: 11.4 kg

Inclining Angles (degrees)			Inclining Angles (degrees)		
ROLL PORT DOWN		Theta (deg)	***ROLL STBD DOWN***		Theta (deg)
Initial	-0.3100		Initial	-0.3100	
Weight Fwd 1	3.6000	3.9100	Weight Aft 1	3.6000	3.9100
Initial	-0.3100	3.9100	Initial	-0.3100	3.9100
Weight Fwd 2	3.6000	3.9100	Weight Aft 2	3.6000	3.9100
Initial	-0.3100	3.9100	Initial	-0.3100	3.9100
Theta (mean)		3.9100	Theta (mean)		3.9100

Theta (mean) for bow up and bow down= 3.910

	ROLL
TRIMMING MASS (kg)	0
DISTANCE FROM KE (X) (m, + fwd)	0
DISTANCE FROM KE (Y) (m, + stbd)	0
DISTANCE FROM KE (Z) (m, + down)	0
Correction to Inertia of System (kg-m^2):	0
Restoring Moment of System (G1b1) (Nm):	1248.20
Restoring Moment of Frame (G0b0t) (Nm):	235.01
Restoring Moment of Inclinometer (Gibi) (Nm):	-1.00
Restoring Moment of Model (Gbt) (Nm):	1014.18
CG of Model and Trim Weight from KE (m):	0.681
VCG of Model and Trim Weight from keel (m):	0.465
VCG of Model from keel (m):	0.4647

Inertia of model

ROLL IN AIR		
Cycles	Time (sec)	Period (sec)
10	23.2	2.320
10	23.2	2.320
10	23.2	2.320
	MEAN	**2.320**

	ROLL
Inertia of Entire System about KE (kg-m^2)	170.18
Inertia of Frame about KE (kg-m^2)	86.65
Inertia of Model about KE (kg-m^2)	83.52
Parallel Axis Correction (kg-m^2)	70.45
Inertia of Model about own CG (kg-m^2)	13.07
Radius of Gyration (m)	0.293
Radius of Gyration/Beam	**0.317**

FINAL RESULTS	
VCG (Pitch) From keel (m)	*0.410*
VCG (Roll) From keel (m)	*0.465*
Radius of Gyration (Pitch) (m)	*0.596*
Radius of Gyration (Roll) (m)	*0.293*

CCGA ATLANTIC SWELL INCLINING EXPERIMENT RESULTS

Model #IOT651 Scale 1:4.697 January 2005

Fishing Vessel Research Project #2017

IOT Tow Tank - North Trim Dock

Ship GM_T was determined to be 1.349 m during an inclining experiment performed October 2, 2003 (Ref. TR-2003-28, App. A).

Ship roll period as measured in St. John's harbour was determined to be 3.2226 s. (Ref. TR-2003-28, p. 16)
There was no dedicated ballast on model, thus batteries were used as inclining weights.

Model scale target GM_T = 28.72 cm.
Model scale target Roll Period = 1.487 s.
Model Displacement = 150.5 kg

GM_T = w*d/W*tan(phi)

where: w = inclining weight (kg)
d = distance inclining weight moved (cm)
W = model displacement (kg)
phi = model inclined heel angle (deg.)

Inclining Experiment #1: **Jan. 4, 2005**

Inclining weight: moved 5.5887 kg battery secured just off model centerline up to main deck 33.02 cm up.
Correction to VCG due to moving inclining weight up to main deck: 5.5887 kg * 33.02 cm/ 150.5 kg = 1.226 cm
Inclining weight shifted to port: inclining angle = 2.27 deg.
Inclining weight shifted to stbd.: inclining angle = 3.63 deg.
Distance inclining weight moved across main deck: 73.34 cm

GM_T = 5.5887 kg * 73.34 cm/ 150.5 kg * tan (2.27 + 3.63) deg.
= 26.35 cm + correction to VCG (1.226 cm)
= 27.58 cm

Inclining Experiment #2: **Jan. 4, 2005**

Inclining weight: moved 5.5887 kg battery secured just off model centerline up to main deck 33.02 cm up.
Correction to VCG due to moving inclining weight up to main deck: 5.5887 kg * 33.02 cm/ 150.5 kg = 1.226 cm
Inclining weight shifted to port: inclining angle = 1.02 deg.
Inclining weight shifted to stbd.: inclining angle = 2.35 deg.
Distance inclining weight moved across main deck (port & stbd. of rudder servo): 42.23 cm

GM_T = 5.5887 kg * 42.23 cm/ 150.5 kg * tan (2.35 + 1.02) deg.
= 26.63 cm + correction to VCG (1.226 cm)
= 27.86 cm

Roll period check:	5.84 s / 5 cycles	1.168 s
	6.03 s / 5 cycles	1.206 s

Will increase GM_T by moving shelf with 4 * ~ 4 kg batteries on fwd. upper deck down ~ 7.6 cm.
Made adjustments to distribution of batteries in model to improve roll period.
Move weight up & outboard.

Roll period check:	6.18 s / 5 cycles	1.236 s
	6.59 s / 5 cycles	1.318 s
	6.56 s / 5 cycles	1.312 s

Move additional weight up & outboard.

Roll period check:	6.93 s / 5 cycles	1.386 s
	7.03 s / 5 cycles	1.406 s
	6.00 s / 5 cycles	1.400 s

Inclining Experiment #3: **Jan. 5, 2005**

Inclining weight: moved 4.0946 kg battery
Inclining weight shifted to port: inclining angle = 2.92 deg.
Inclining weight shifted to stbd.: inclining angle = -2.92 deg.
Distance inclining weight moved across upper deck, fwd. superstructure: 55.2 cm

GM_T = 4.0946 kg * 55.2 cm/ 150.5 kg * tan (2.92) deg.
= 29.44 cm

Inclining Experiment #4: **Feb. 21, 2005** **Post-Test Inclining**

Inclining weight: moved 4.0823 kg battery
Inclining weight shifted to port: inclining angle = 2.93 deg.
Inclining weight shifted to stbd.: inclining angle = -2.93 deg.
Distance inclining weight moved across upper deck, fwd. superstructure: 55.2 cm

GM_T = 4.0823 kg * 55.2 cm/ 150.5 kg * tan (2.93) deg.
= 29.25 cm

Final values are a compromise between target GM_T and model roll period.

Final GM_T = 29.25 cm
Final nominal roll period = 1.40 s. Roll period to be confirmed at zero, 4 and 8 knots in OEB
Pitch period to be determined in OEB for zero forward speed in OEB.

APPENDIX B: HYDROSTATICS FOR SHIP AND PHYSICAL MODEL

CCGA ATLANTIC SWELL
Model #IOT651
Model Test Condition

Fishing Vessel Research Proj. 2017

HYDROSTATICS WITHOUT APPENDAGES **Scale 1: 4.697**

	Ship	Model
LENGTH BETWEEN PERPENDICULARS, m	9.66	2.056
LENGTH ON THE WATERLINE, m	9.69	2.063
LENGTH OVERALL, m	10.65	2.267
MAXIMUM WATERLINE BEAM, m	4.35	0.927
DRAFT AT MIDSHIPS, m	1.46	0.310
DRAFT ABOVE DATUM AT AFT PERPENDICULAR, m	1.44	0.307
DRAFT ABOVE DATUM AT FWD PERPENDICULAR, m	1.47	0.312
TRIM, deg.	0.14	0.139
EQUIVALENT LEVEL KEEL DRAFT ABOVE BASELINE, m	1.45	0.310
PARALLEL MIDDLE BODY WRT AP, m	NA	NA
TO, m	NA	NA
CENTRE OF BUOYANCY WRT AP, m	4.51	0.960
CENTRE OF BUOYANCY ABOVE BASELINE, m	1.13	0.240
CENTRE OF FLOTATION WRT AP, m	4.16	0.886
WATERPLANE AREA, sq. m	31.11	1.410
WETTED SURFACE AREA, sq.m	43.86	1.988
WETTED SURFACE AREA, (EXCLUDING TRANSOM) sq.m	43.41	1.968
MIDSHIP SECTIONAL AREA, sq.m	2.49	0.113
TRANSVERSE METACENTRIC RADIUS, m	4.13	0.879
LONGITUDINAL METACENTRIC RADIUS, m	13.29	2.829
VOLUME OF DISPLACEMENT, cu. m	15.72	0.152
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	16.12	151.721

MASS PROPERTIES

CENTER OF GRAVITY ABOVE BASELINE, m	1.94	0.413
TRANSVERSE METACENTRE HEIGHT, m	3.32	0.706
LONGITUDINAL METACENTRE HEIGHT, m	12.47	2.655

APPENDAGES

CENTRE OF BUOYANCY WRT AP, m	NA	NA
VOLUME OF DISPLACEMENT, cu. m	NA	NA
WETTED SURFACE AREA, sq.m	NA	NA

3/24/2005

CCGA ATLANTIC SWELL
Model #IOT651
Model Test Condition

COEFFICIENTS OF FORM FOR NAKED HULL

Fishing Vessel Research Proj. 2017

COEFFICIENTS BASED ON: LENGTH ON WATERLINE
MAXIMUM BEAM
EQUIVALENT LEVEL KEEL DRAFT

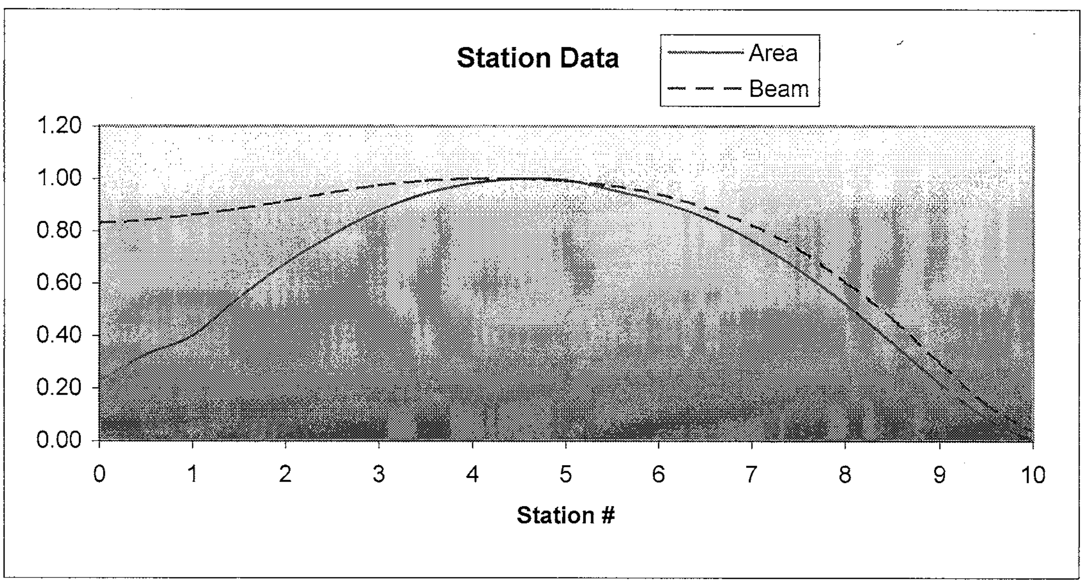
L/B	2.218
L/T	6.640
B/T	2.994
LCB %L FORWARD OF AP	46.701
LCF %L FORWARD OF AP	43.118
BLOCK COEFFICIENT	0.256
MIDSHIP COEFFICIENT	0.393
PRISMATIC COEFFICIENT	0.652
WATERPLANE COEFFICIENT	0.737
LONGITUDINAL INERTIA OF WATERPLANE	0.979
TRANSVERSE INERTIA OF WATERPLANE	0.640
BM/B	0.949
BML/L	1.248
BEAM - DISPLACEMENT RATIO	1.738
DRAFT - DISPLACEMENT RATIO	0.580
LENGTH - DISPLACEMENT RATIO	3.854
WETTED SURFACE - DISPLACEMENT RATIO	6.989
BM - DISPLACEMENT RATIO	1.649
BML - DISPLACEMENT RATIO	5.304

CCGA ATLANTIC SWELL
Model #IOT651
Model Test Condition

SECTIONAL AREA AND BEAM CURVES

Fishing Vessel Research Proj. 2017

Station	Area	Beam
0	0.224	0.831
0.5	0.327	0.842
1	0.400	0.861
1.5	0.545	0.885
2	0.676	0.915
2.5	0.785	0.948
3	0.879	0.975
3.5	0.944	0.992
4	0.984	1.000
4.5	1.000	1.000
5	0.995	0.991
5.5	0.957	0.974
6	0.913	0.941
6.5	0.852	0.890
7	0.764	0.823
7.5	0.654	0.733
8	0.523	0.606
8.5	0.373	0.466
9	0.220	0.300
9.5	0.088	0.141
10	0.002	0.037



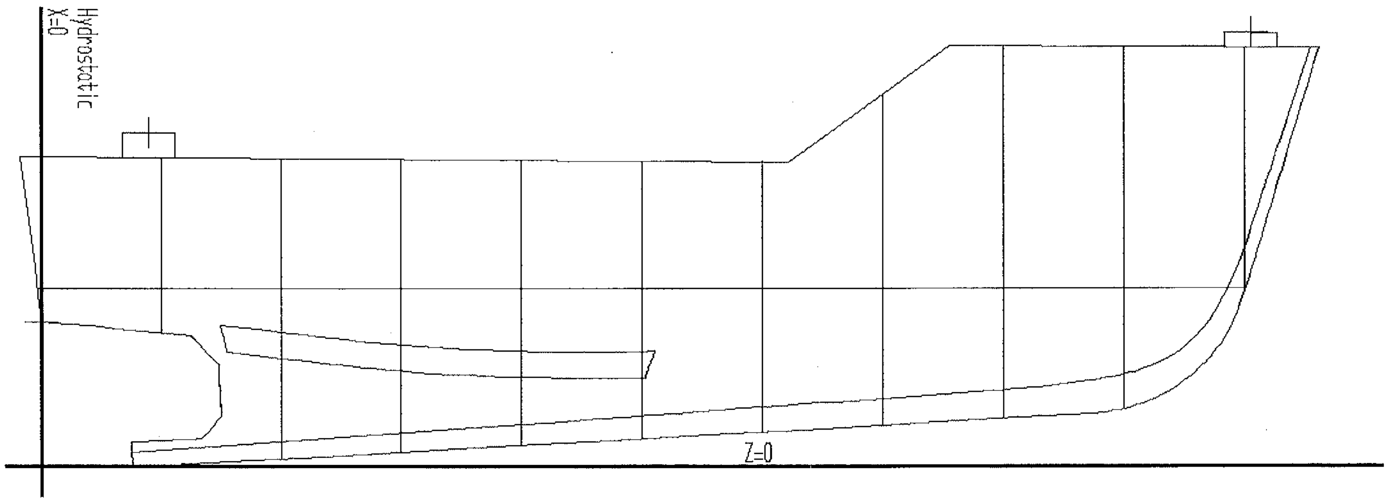
Definitions:
Area = Station Area / Max. Sectional Area
Beam = Station Beam / Max. Section Beam

3/24/2005

CCGA Atlantic Swell

Model #IOT651

Fishing Vessel Research Proj. 2017



NOTE:
All numbers are taken from the AP X=0 and the base line Z=0. The base line is at the bottom of the skeg. (regarding IOT651 Standard_hydro.xls)
The drawings received from ship owner all had different values for x & z and different angles on the skeg and sometimes hull rotation .
From (baseline 4/client) I took the AP/FP/CG and waterline from the first drawing relative to the bottom of the stern and placed it
(after scaling) into our drawings to get the appropriate drafts and perpendiculars.

APPENDIX C: INSTRUMENTATION CALIBRATION RESULTS

Calibration of OEBDAS Channel 1 13:46 27 October 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Calibration WP **Model:** 2 m **Serial Number:** D00

Programmable Gain: 1 **Plug-In Gain:** 10 **Filter Frequency:** 10.0 Hz

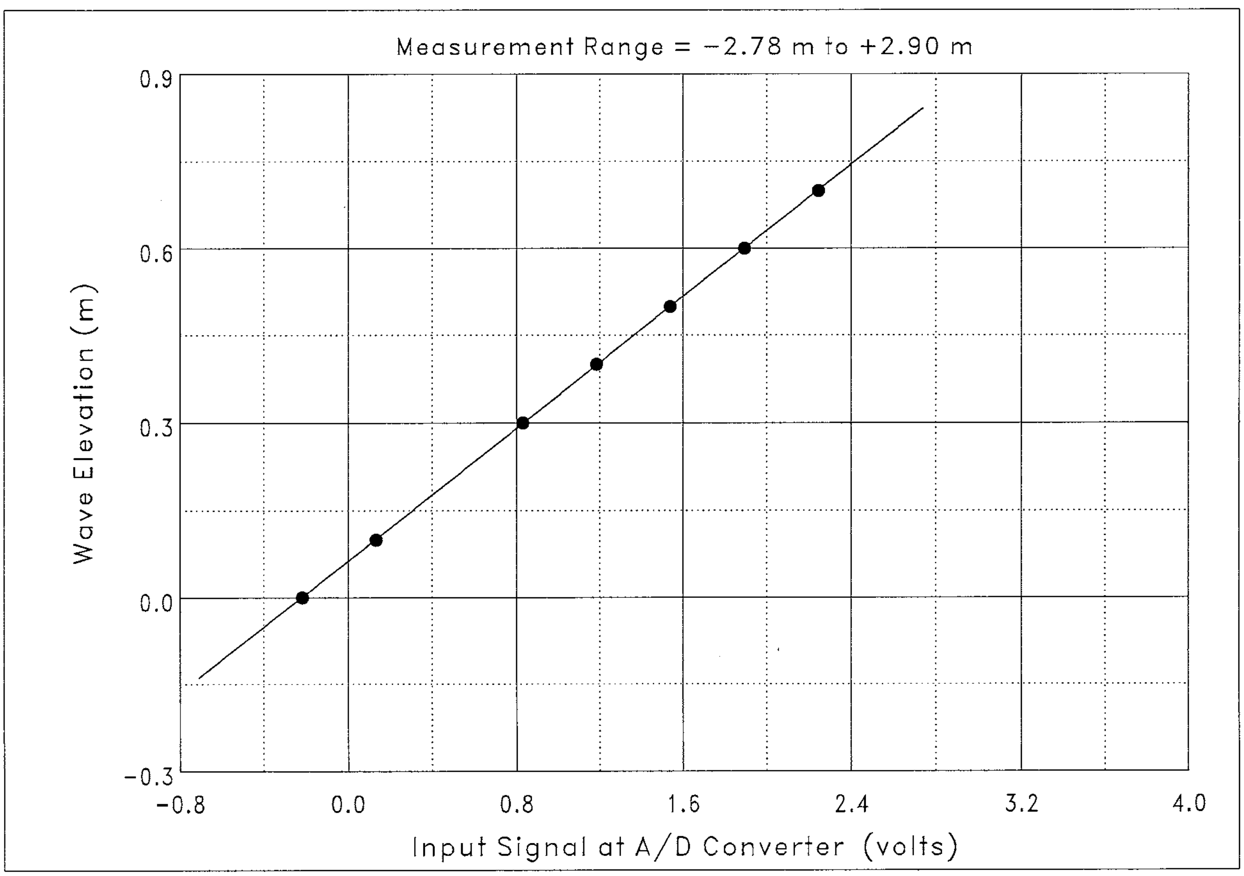
Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−0.218	0.00000	0.00091	0.0009107	
2	0.133	0.10000	0.10043	0.0004331	
3	0.829	0.30000	0.29827	−0.0017296	⇐ Maximum Error
4	1.184	0.40000	0.39906	−0.0009389	
5	1.540	0.50000	0.50019	0.0001851	
6	1.892	0.60000	0.60045	0.0004475	
7	2.245	0.70000	0.70069	0.0006921	
Maximum Error = −0.247 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Wave Elevation (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0627460 m,
and C_1 = 0.284125 m/volt .



Calibration of OEBDAS Channel 18 — 14:01 — 22 December 2004

Project: Fishing Vessel Safety — **Facility:** OEB

Sensor: S/W WP — **Model:** 2M — **Serial Number:** I-01

Programmable Gain: 1 — **Plug-In Gain:** 4 — **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−0.460	0.00000	−0.00018	−0.00017507	
2	0.077	0.10000	0.10030	0.00029975	
3	0.609	0.20000	0.19997	−0.00003104	
4	1.142	0.30000	0.29966	−0.00033662	
5	1.681	0.40000	0.40042	0.00041559	
6	2.214	0.50000	0.50014	0.00013590	
7	2.745	0.60000	0.59942	−0.00058150	⇐ Maximum Error
8	3.284	0.70000	0.70027	0.00027299	

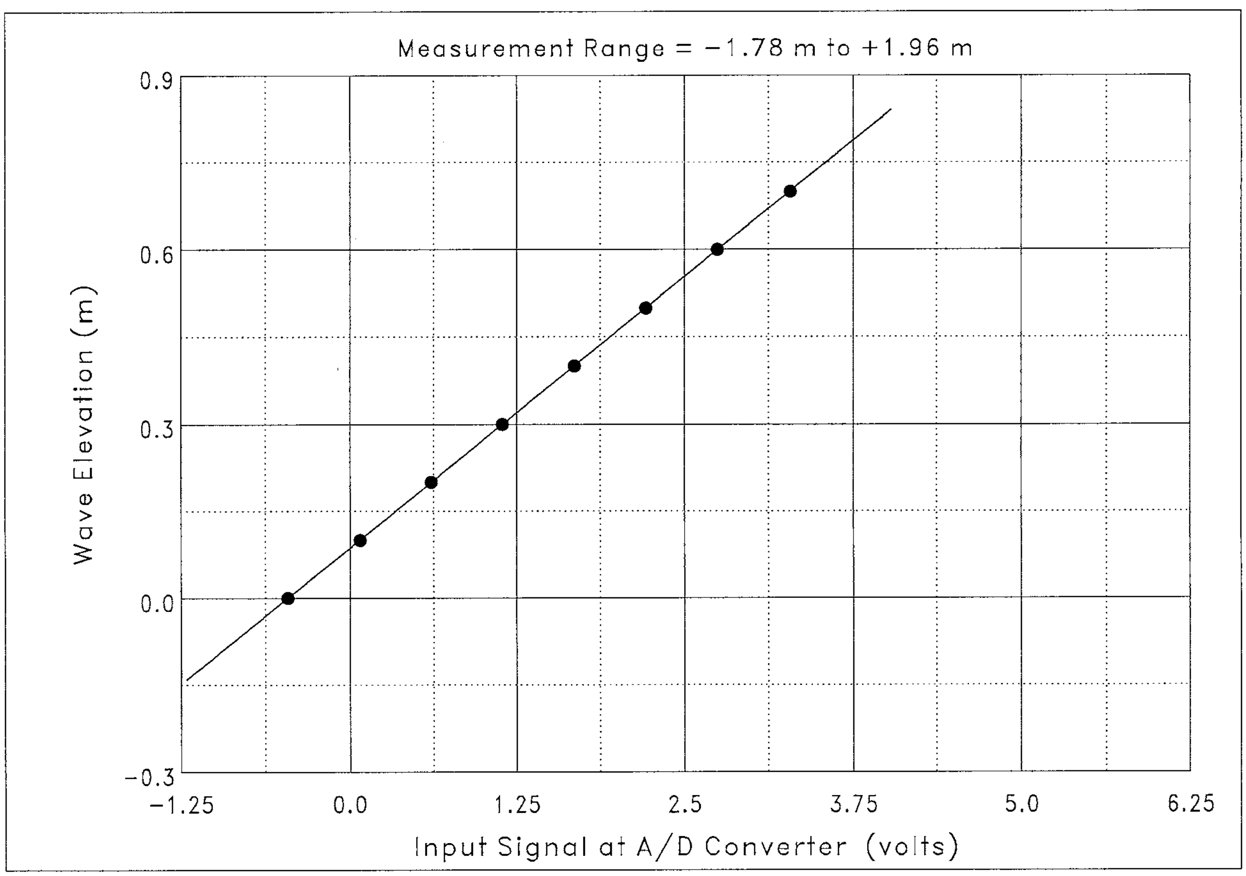
Maximum Error = −0.0831 % of Calibration Range.

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Wave Elevation (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0859664 m,
and C_1 = 0.187067 m/volt.



Calibration of OEBDAS Channel 17 14:01 22 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: S/C WP **Model:** 2M **Serial Number:** I-00

Programmable Gain: 1 **Plug-In Gain:** 4 **Filter Frequency:** 10.0 Hz

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−0.629	0.00000	0.00148	0.0014815	
2	−0.100	0.10000	0.10016	0.0001624	
3	0.431	0.20000	0.19941	−0.0005932	
4	0.962	0.30000	0.29841	−0.0015869	⇐ Maximum Error
5	1.503	0.40000	0.39928	−0.0007193	
6	2.042	0.50000	0.49995	−0.0000538	
7	2.580	0.60000	0.60030	0.0003012	
8	3.120	0.70000	0.70101	0.0010080	
Maximum Error = −0.227 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

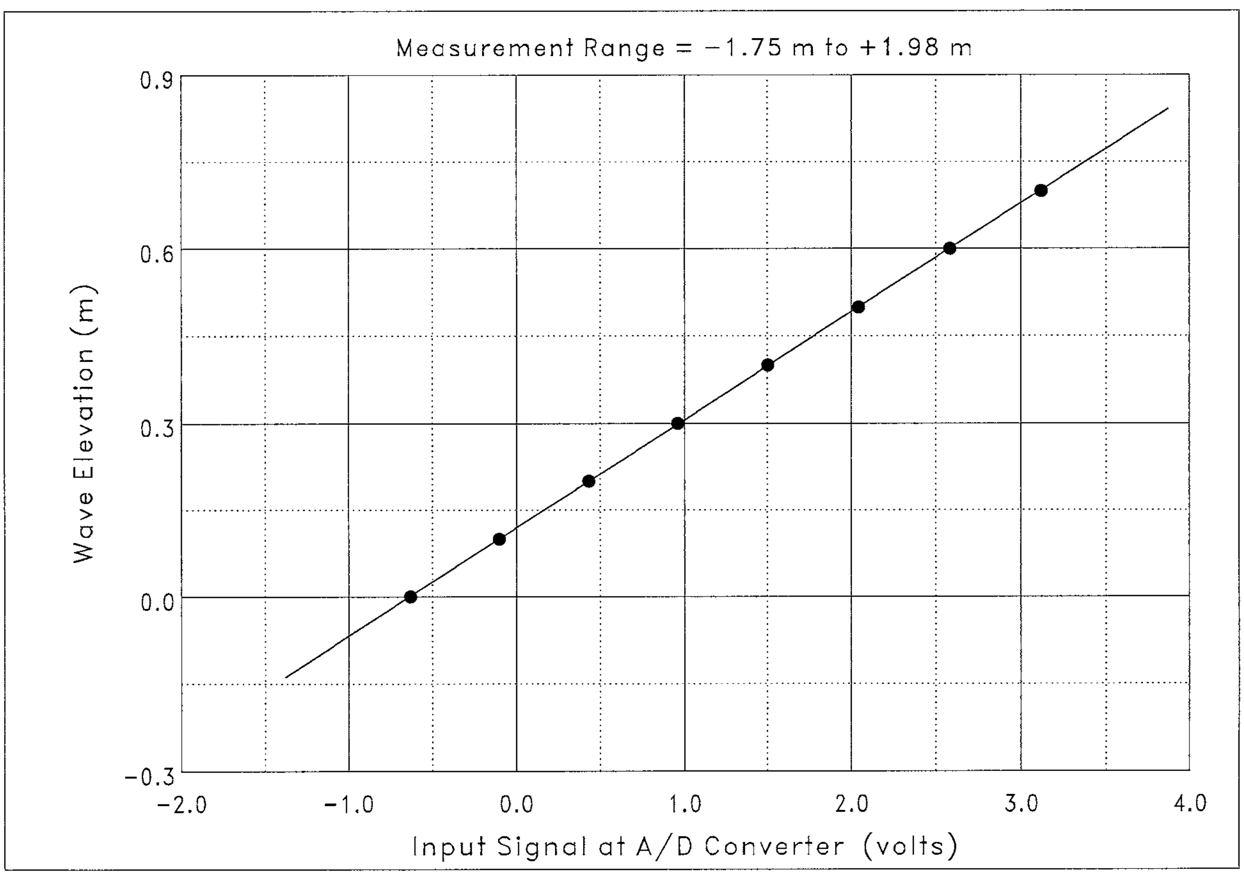
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Wave Elevation (m),

$V(t)$ = input signal at A/D converter (volts),

C_0 = 0.118911 m,

and C_1 = 0.186557 m/volt.



Calibration of OEBDAS Channel 20 14:01 22 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: S/E WP (P7) **Model:** 2M **Serial Number:** I-03

Programmable Gain: 1 **Plug-In Gain:** 1

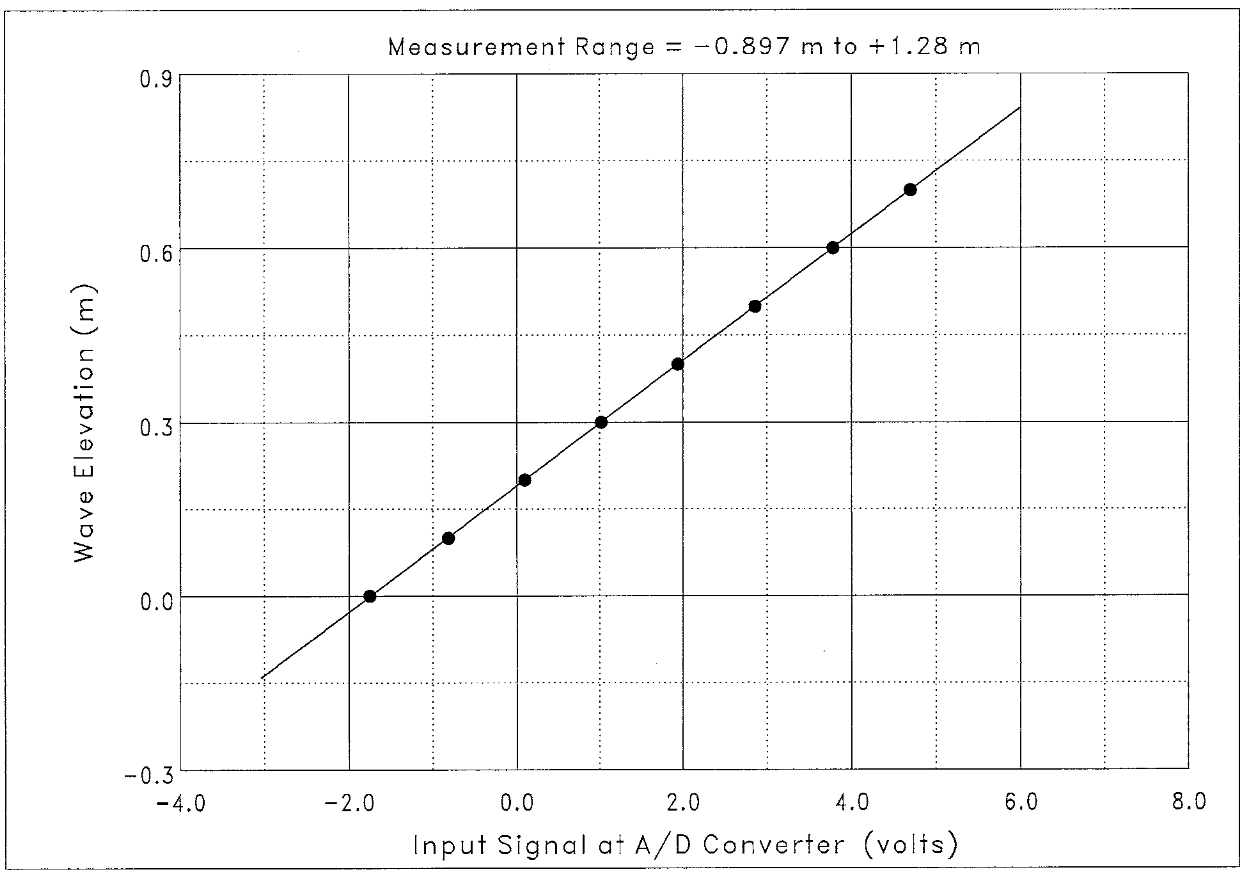
Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−1.751	0.00000	−0.00074	−0.00074099	
2	−0.816	0.10000	0.10076	0.00076319	⇐ Maximum Error
3	0.096	0.20000	0.19993	−0.00007407	
4	1.020	0.30000	0.30022	0.00021514	
5	1.940	0.40000	0.40025	0.00025225	
6	2.856	0.50000	0.49969	−0.00031272	
7	3.779	0.60000	0.60000	0.00000000	
8	4.699	0.70000	0.69990	−0.00010276	
Maximum Error = 0.109 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Wave Elevation (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.189449 m,
and C_1 = 0.108639 m/volt .



Calibration of OEBDAS Channel 4 — 14:01 22 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: N/C WP (P9) **Model:** 2M **Serial Number:** D03

Programmable Gain: 1 **Plug-In Gain:** 1

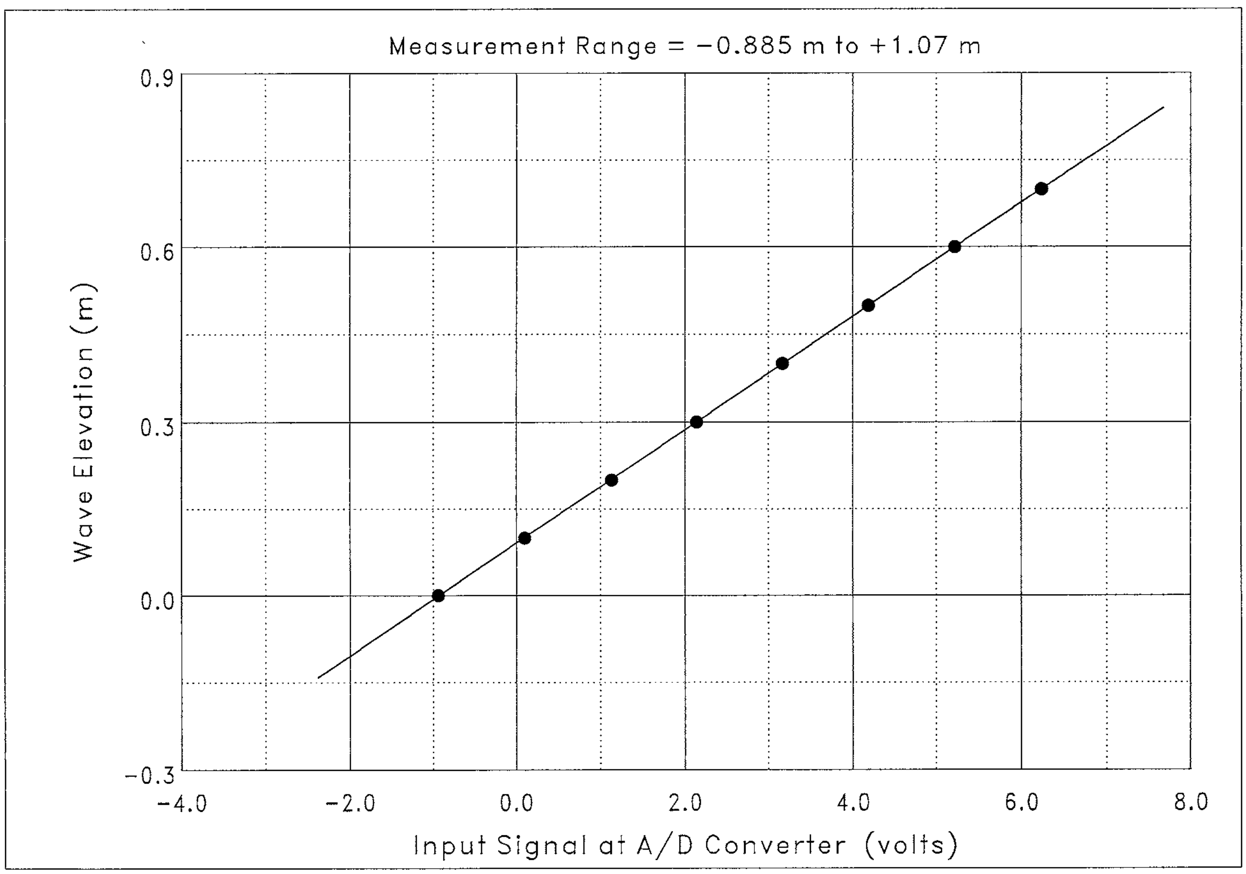
Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−0.943	0.00000	−0.00114	−0.0011424	
2	0.099	0.10000	0.10064	0.0006361	
3	1.131	0.20000	0.20132	0.0013150	⇐ Maximum Error
4	2.140	0.30000	0.29976	−0.0002422	
5	3.163	0.40000	0.39962	−0.0003820	
6	4.190	0.50000	0.49985	−0.0001518	
7	5.217	0.60000	0.60006	0.0000607	
8	6.240	0.70000	0.69991	−0.0000933	
Maximum Error = 0.188 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Wave Elevation (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0909291 m,
and C_1 = 0.0975951 m/volt .



Calibration of DASPC16 Channel 2 10:51 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: X accel **Model:** MotionPak **Serial Number:** 0689

Programmable Gain: 1

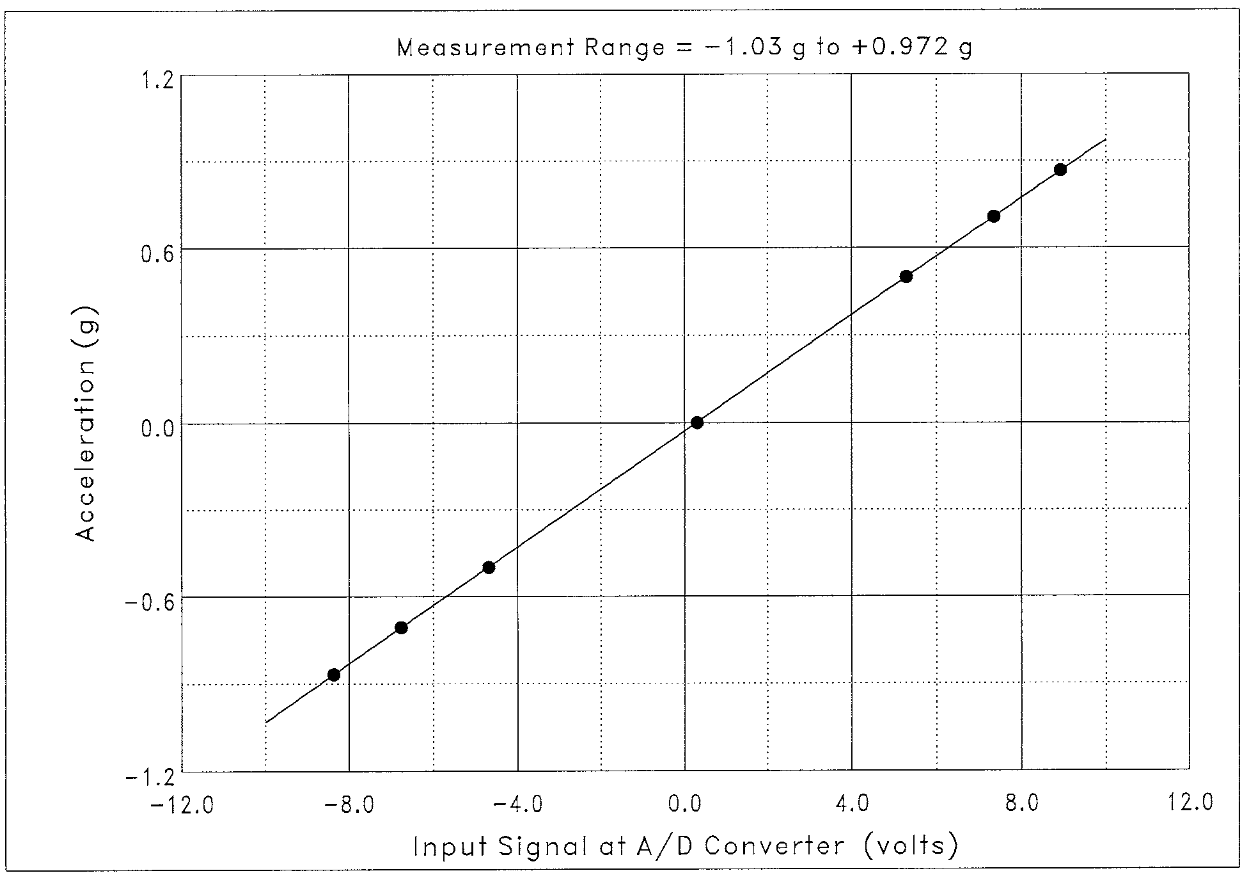
Data Point No.	Input Signal (volts)	Physical Value (g)	Fitted Curve Value (g)	Error (g)	
1	0.306	0.00000	0.00132	0.0013216	
2	5.287	0.50000	0.50012	0.0001197	
3	7.346	0.70700	0.70636	−0.0006437	
4	8.937	0.86600	0.86559	−0.0004105	
5	−4.690	−0.50000	−0.49902	0.0009795	
6	−6.764	−0.70700	−0.70668	0.0003193	
7	−8.372	−0.86600	−0.86769	−0.0016859	⇐ Maximum Error
Maximum Error = −0.0973 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −0.0293232 g,
and C_1 = 0.100141 g/volt .



Calibration of DASPC16 Channel 3 11:04 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Y accel **Model:** MotionPak **Serial Number:** 0689

Programmable Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (g)	Fitted Curve Value (g)	Error (g)	
1	0.008	0.00000	−0.00269	−0.0026917	
2	−4.965	−0.50000	−0.50066	−0.0006581	
3	−8.596	−0.86600	−0.86419	0.0018136	
4	−7.022	−0.70700	−0.70660	0.0004039	
5	5.018	0.50000	0.49892	−0.0010816	
6	7.088	0.70700	0.70619	−0.0008079	
7	8.714	0.86600	0.86902	0.0030218	⇐ Maximum Error
Maximum Error = 0.174 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

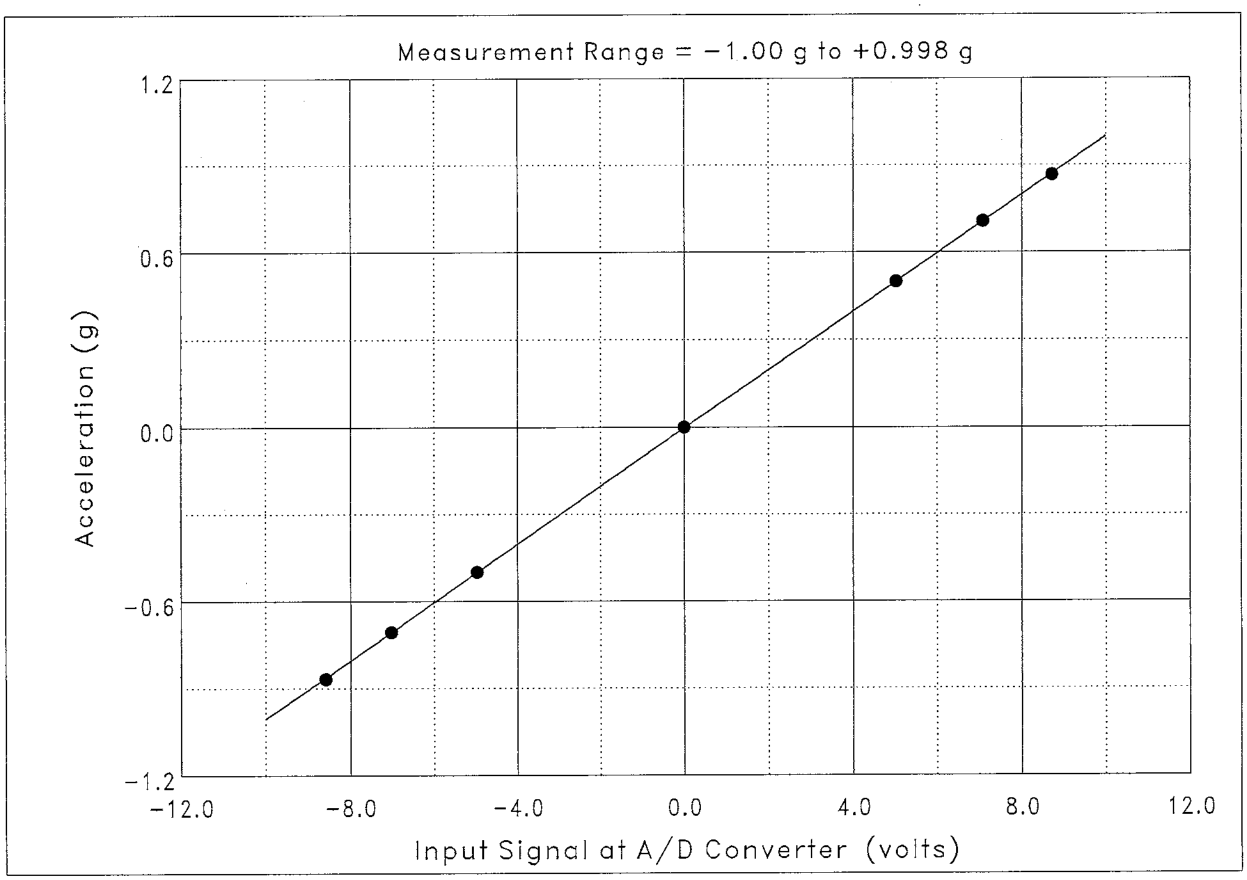
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),

$V(t)$ = input signal at A/D converter (volts),

C_0 = -0.00350901 g,

and C_1 = 0.100125 g/volt .



Calibration of DASPC16 Channel 4 11:32 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Z accel **Model:** MotionPak **Serial Number:** 0689

Programmable Gain: 1

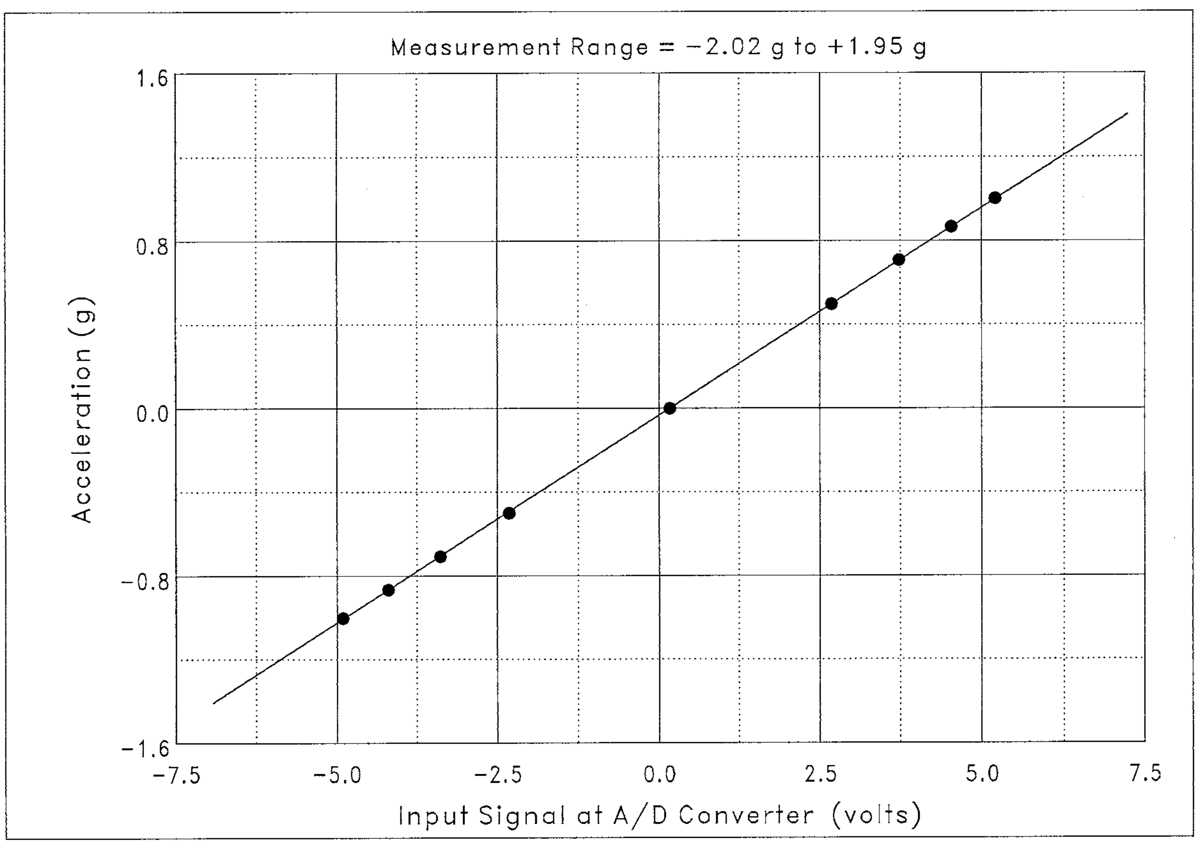
Data Point No.	Input Signal (volts)	Physical Value (g)	Fitted Curve Value (g)	Error (g)	
1	−4.905	−1.0000	−1.0061	−0.0060705	
2	−4.202	−0.8660	−0.8667	−0.0007171	
3	−3.387	−0.7070	−0.7051	0.0019131	
4	−2.316	−0.5000	−0.4928	0.0072030	⇐ Maximum Error
5	0.170	0.0000	0.0002	0.0001596	
6	2.687	0.5000	0.4993	−0.0007305	
7	3.730	0.7070	0.7060	−0.0009807	
8	4.537	0.8660	0.8660	−0.0000221	
9	5.209	1.0000	0.9992	−0.0007547	
Maximum Error = 0.360 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −0.0335872 g,
and C_1 = 0.198273 g/volt .



Calibration of DASPC16 Channel 5 12:09 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: X rate **Model:** MotionPak **Serial Number:** 0689

Programmable Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (deg/s)	Fitted Curve Value (deg/s)	Error (deg/s)	
1	3.212	25.000	25.060	0.060204	
2	1.948	15.000	14.927	−0.073198	⇐ Maximum Error
3	−1.782	−15.000	−14.976	0.024203	
4	−3.035	−25.000	−25.028	−0.027925	
5	−5.524	−45.000	−44.983	0.016720	
6	5.699	45.000	45.000	−0.000004	
Maximum Error = −0.0813 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

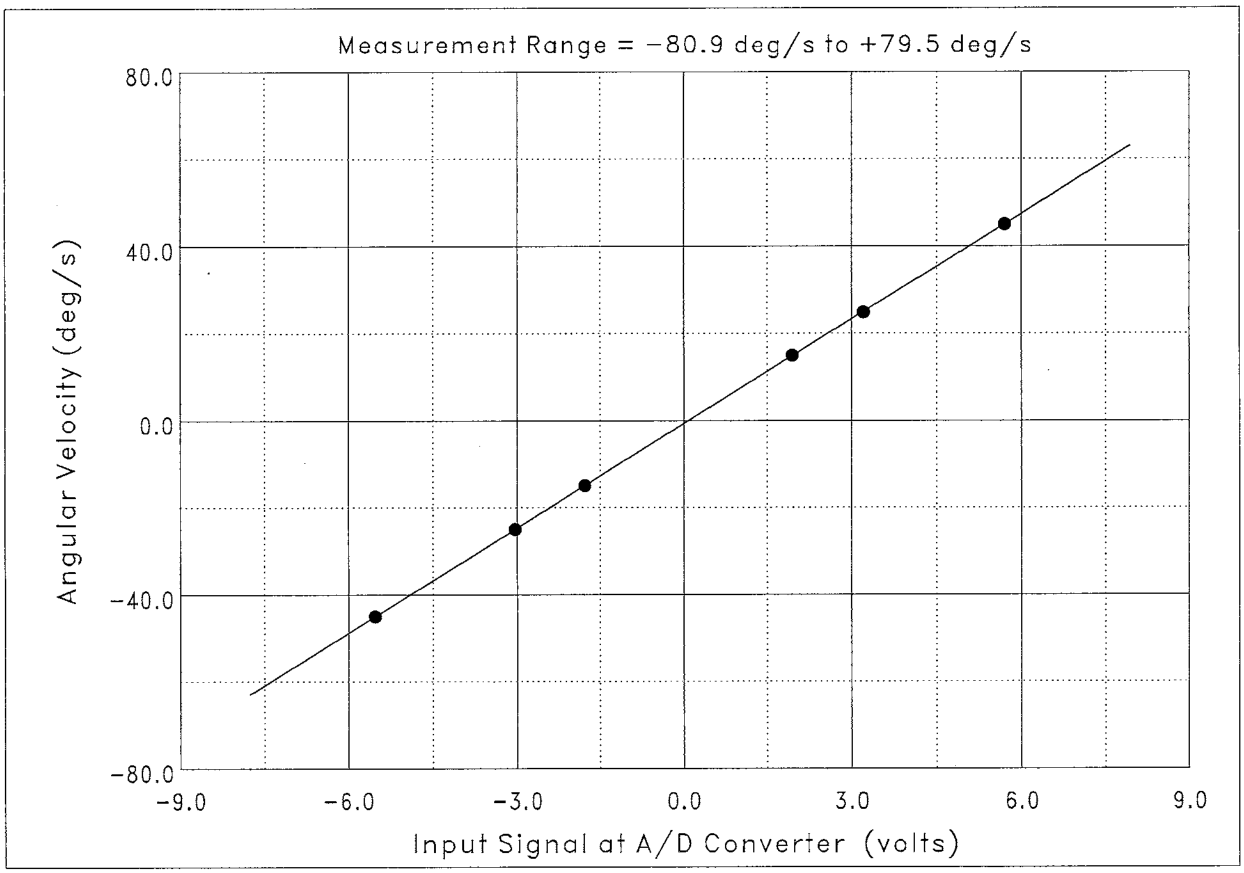
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angular Velocity (deg/s),

$V(t)$ = input signal at A/D converter (volts),

C_0 = −0.691879 deg/s,

and C_1 = 8.01777 (deg/s)/volt .



Calibration of DASPC16 Channel 6 11:48 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Y rate **Model:** MotionPak **Serial Number:** 0689

Programmable Gain: 1

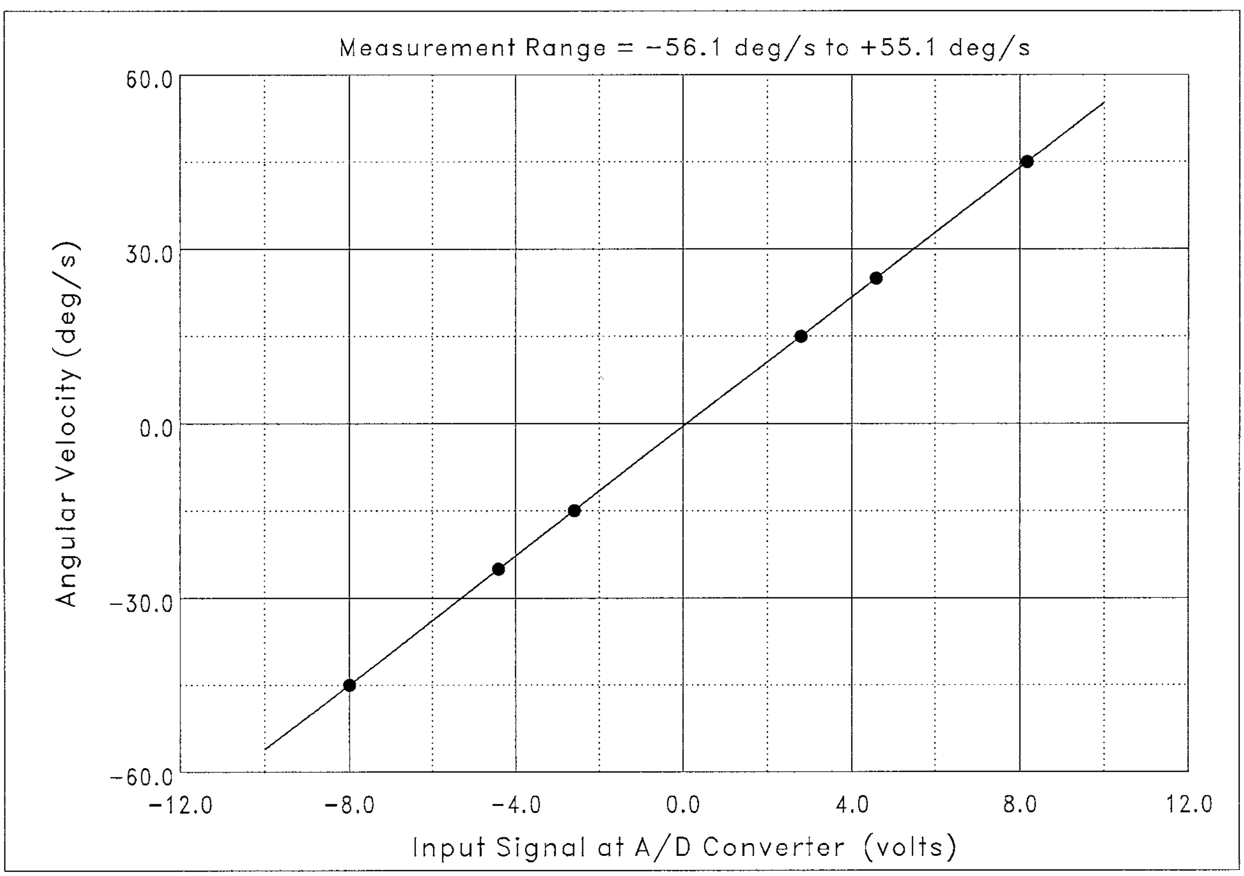
Data Point No.	Input Signal (volts)	Physical Value (deg/s)	Fitted Curve Value (deg/s)	Error (deg/s)	
1	8.178	45.000	44.995	−0.0049782	
2	4.583	25.000	25.000	0.0003834	
3	2.787	15.000	15.007	0.0067883	⇐ Maximum Error
4	−2.607	−15.000	−14.996	0.0039625	
5	−4.407	−25.000	−25.005	−0.0052586	
6	−8.002	−45.000	−45.001	−0.0009003	
Maximum Error = 0.00754 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angular Velocity (deg/s),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −0.492813 deg/s,
and C_1 = 5.56231 (deg/s)/volt .



Calibration of DASPC16 Channel 7 11:55 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Z rate **Model:** MotionPak **Serial Number:** 0689

Programmable Gain: 1

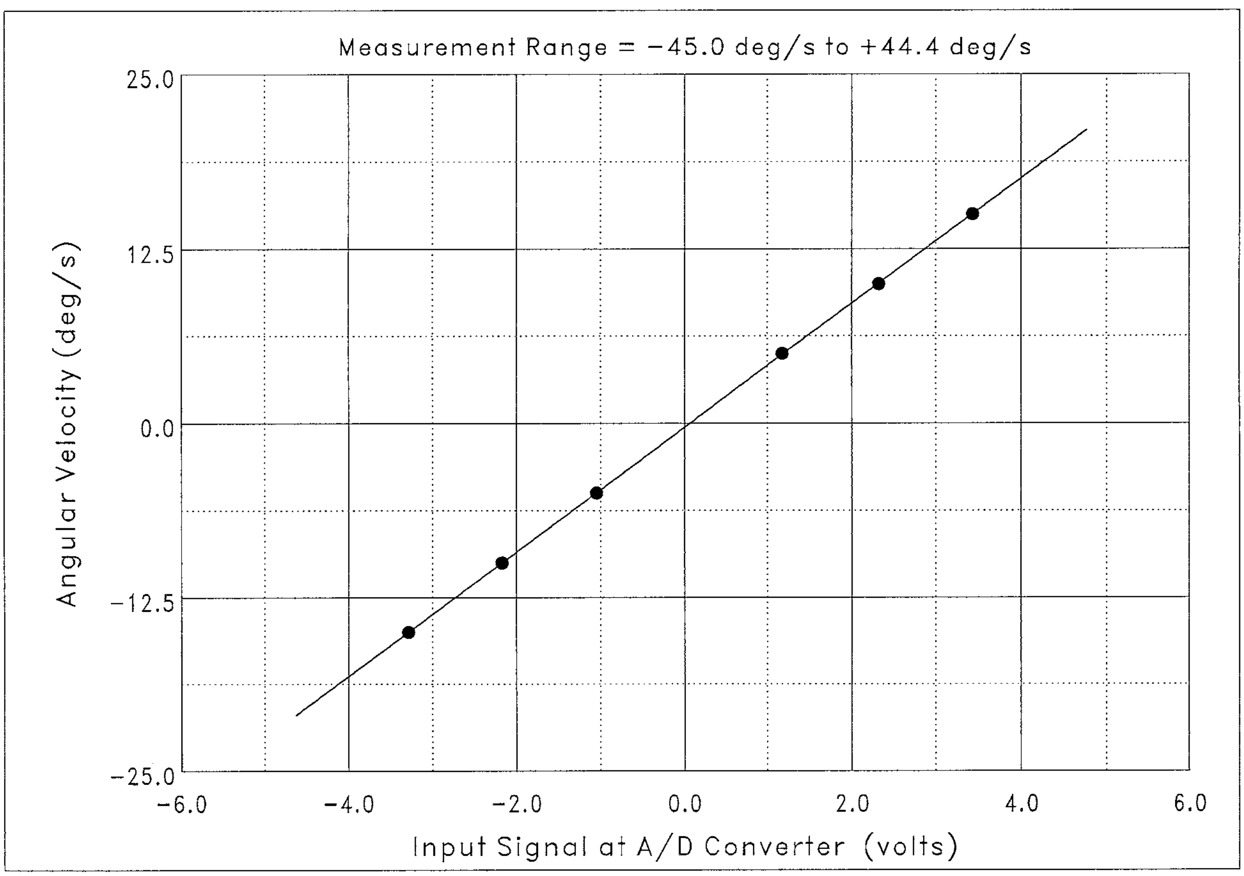
Data Point No.	Input Signal (volts)	Physical Value (deg/s)	Fitted Curve Value (deg/s)	Error (deg/s)	
1	3.428	15.000	15.004	0.004106	
2	2.318	10.000	10.044	0.043974	
3	1.175	5.000	4.938	−0.061699	⇐ Maximum Error
4	−1.049	−5.000	−4.997	0.002921	
5	−2.170	−10.000	−10.005	−0.004748	
6	−3.285	−15.000	−14.985	0.015448	
Maximum Error = −0.206 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angular Velocity (deg/s),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −0.309076 deg/s,
and C_1 = 4.46729 (deg/s)/volt .



Calibration of DASPC16 Channel 10 14:18 10 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Rudder Angle **Model:** Rvdt **Serial Number:** N/A

Programmable Gain: 1

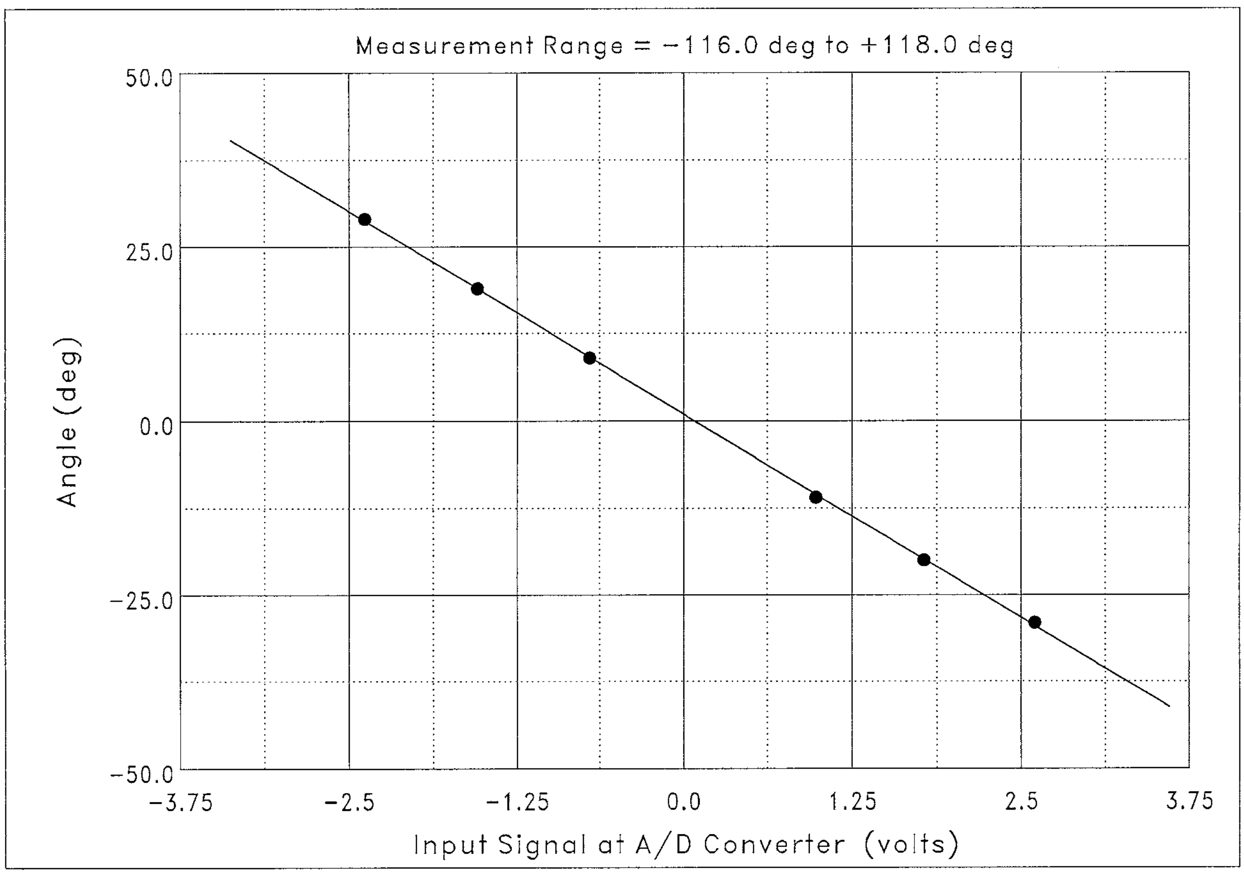
Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	−0.699	9.000	9.100	0.10041	
2	−1.548	19.000	19.004	0.00438	
3	−2.382	29.000	28.752	−0.24836	
4	0.983	−11.000	−10.547	0.45279	
5	1.776	−20.000	−19.814	0.18581	
6	2.605	−29.000	−29.495	−0.49503	⇐ Maximum Error
Maximum Error = −0.854 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.931518 deg,
and C_1 = −11.6784 deg/volt .



Calibration of DASPC16 Channel 1 15:47 10 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: RPM **Model:** Aerotech feedback **Serial Number:** 1410

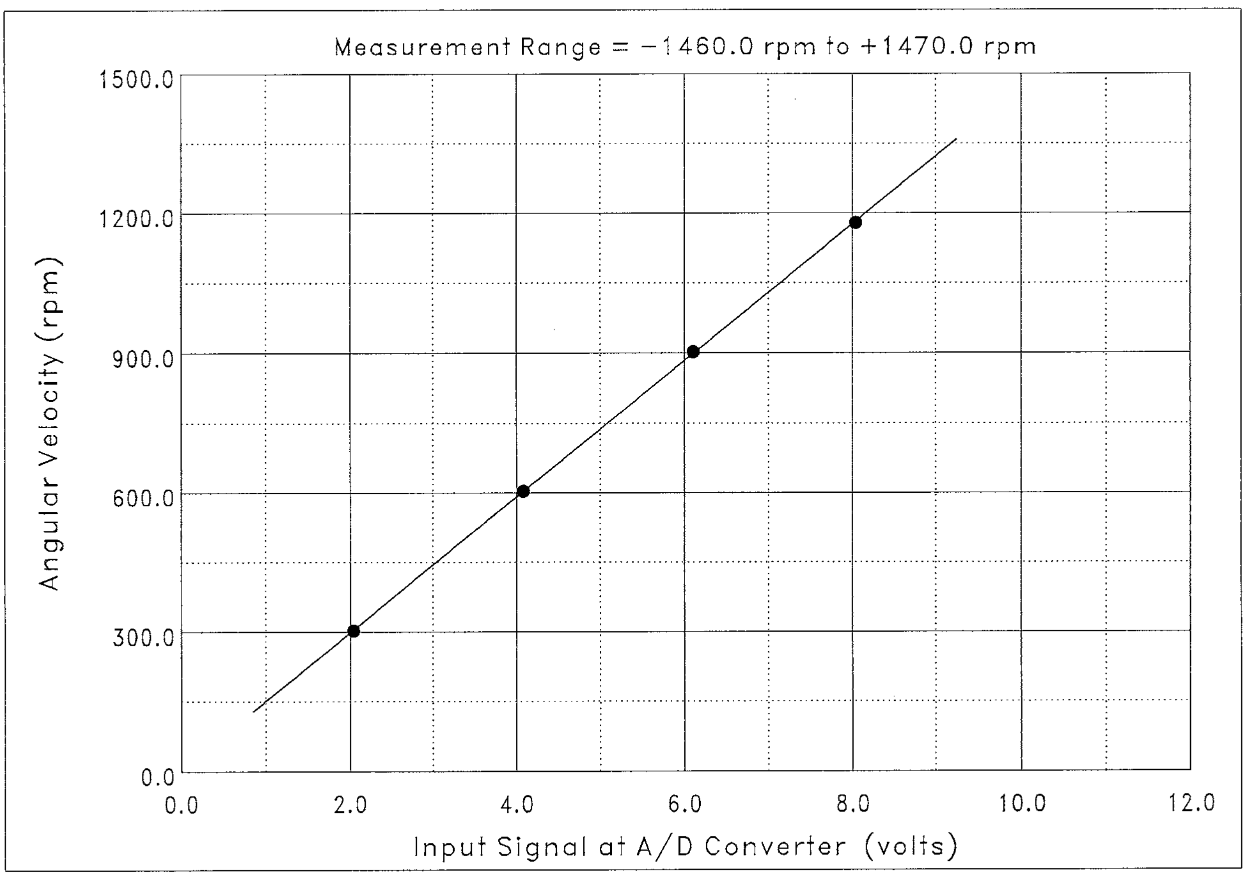
Programmable Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (rpm)	Fitted Curve Value (rpm)	Error (rpm)	
1	2.045	303.0	304.5	1.5372	
2	4.079	603.0	602.4	−0.6373	
3	6.104	902.4	898.9	−3.4550	⇐ Maximum Error
4	8.041	1180.0	1182.6	2.5552	
Maximum Error = −0.394 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angular Velocity (rpm),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 4.99503 rpm,
and C_1 = 146.442 rpm/volt .



Calibration of DASPC16 Channel 8 12:23 20 December 2004

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Sway **Model:** QA650 **Serial Number:** 4072

Programmable Gain: 1

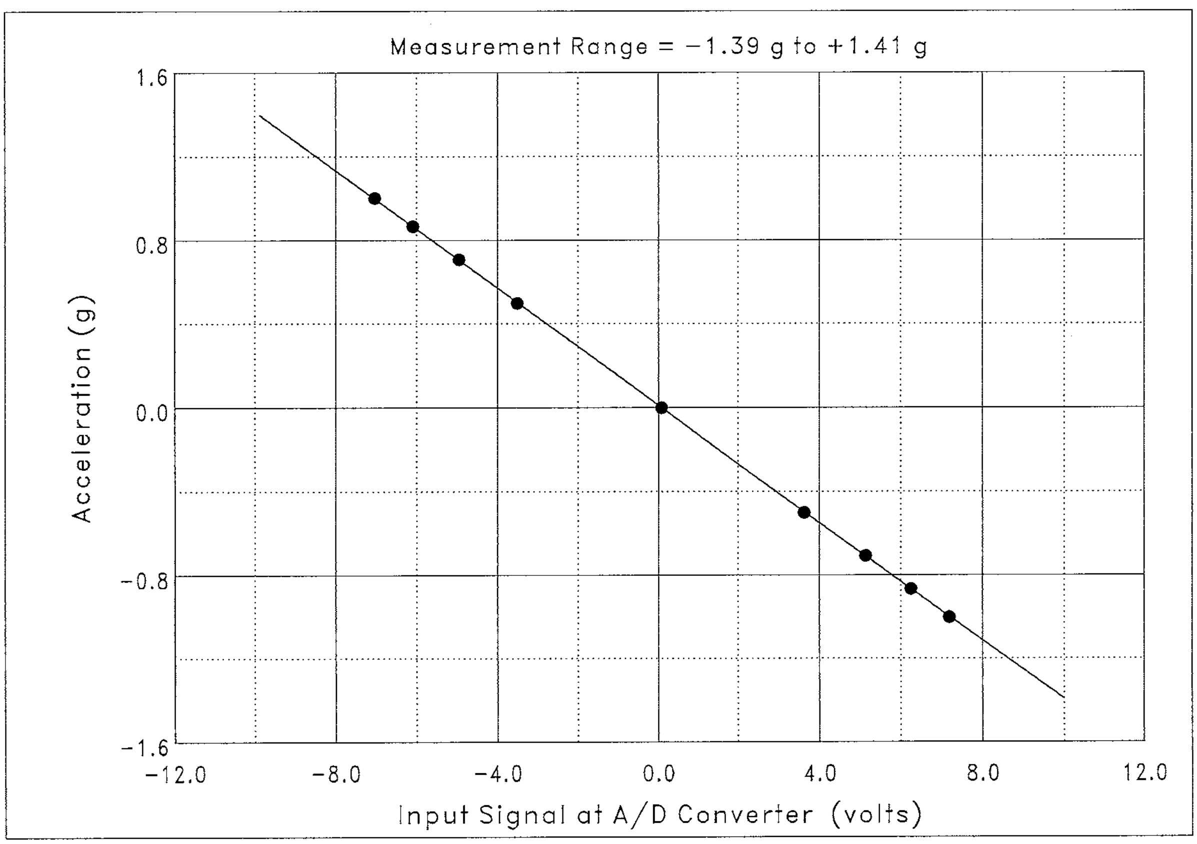
Data Point No.	Input Signal (volts)	Physical Value (g)	Fitted Curve Value (g)	Error (g)	
1	0.080	0.0000	−0.00064	−0.0006378	
2	−3.504	0.5000	0.50238	0.0023810	⇐ Maximum Error
3	−4.959	0.7070	0.70667	−0.0003348	
4	−6.102	0.8660	0.86702	0.0010250	
5	−7.034	1.0000	0.99787	−0.0021303	
6	3.630	−0.5000	−0.49899	0.0010117	
7	5.124	−0.7070	−0.70872	−0.0017190	
8	6.247	−0.8660	−0.86624	−0.0002429	
9	7.195	−1.0000	−0.99935	0.0006471	
Maximum Error = 0.119 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0105563 g,
and C_1 = −0.140365 g/volt .



Calibration of DASPC16 Channel 9   12:33   20 December 2004

Project: Fishing Vessel Safety   **Facility:** OEB

Sensor: Heave   **Model:** QA650   **Serial Number:** 4081

Programmable Gain: 1

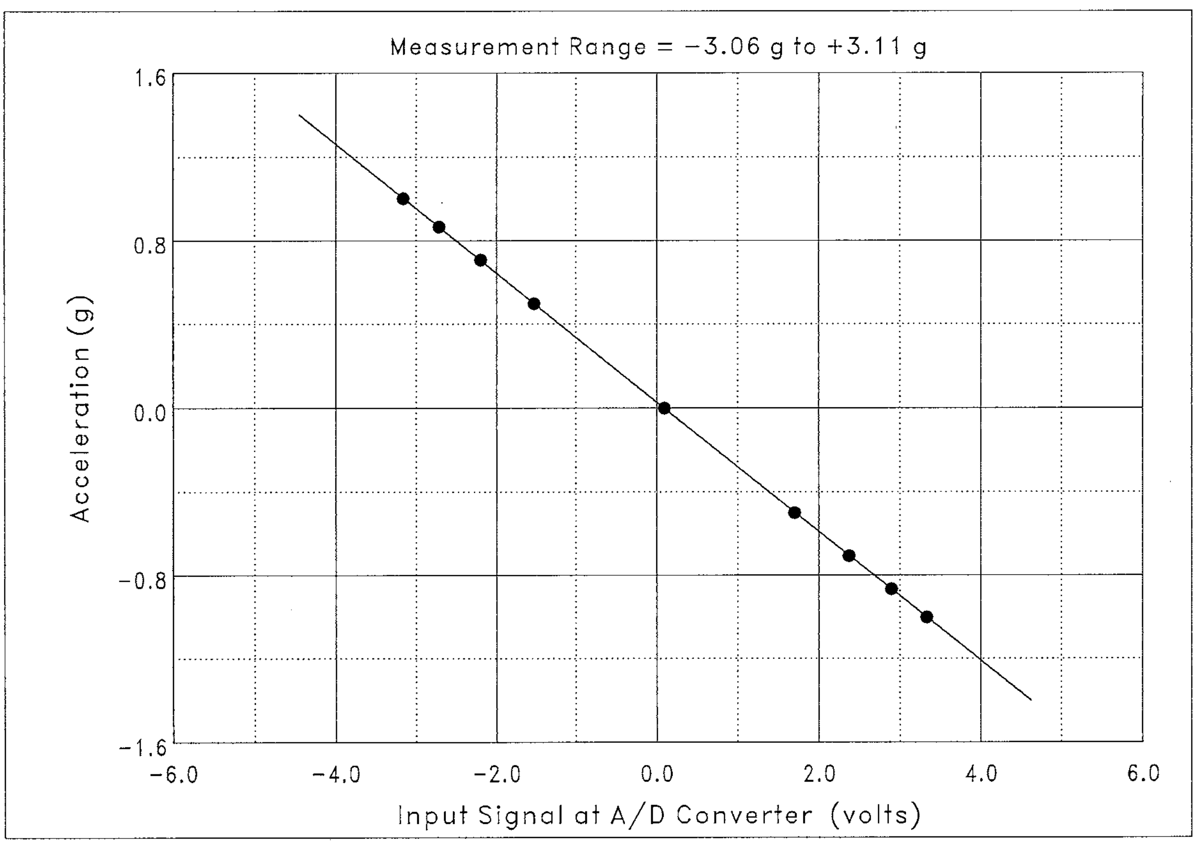
Data Point No.	Input Signal (volts)	Physical Value (g)	Fitted Curve Value (g)	Error (g)	
1	3.330	−1.0000	−1.0009	−0.0008508	
2	2.893	−0.8660	−0.8660	−0.0000258	
3	2.374	−0.7070	−0.7057	0.0013387	
4	1.702	−0.5000	−0.4984	0.0016475	
5	−1.527	0.5000	0.4985	−0.0015392	
6	−2.196	0.7070	0.7050	−0.0019903	
7	−2.718	0.8660	0.8663	0.0003108	
8	−3.160	1.0000	1.0028	0.0027823	⇐ Maximum Error
9	0.093	0.0000	−0.0017	−0.0016731	
Maximum Error = 0.139 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 0.0271409 g,
and C_1 = −0.308737 g/volt .



Calibration of OEBDAS Channel 33 13:47 07 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: X **Model:** QTMDaq **Serial Number:** N/A

Programmable Gain: 1

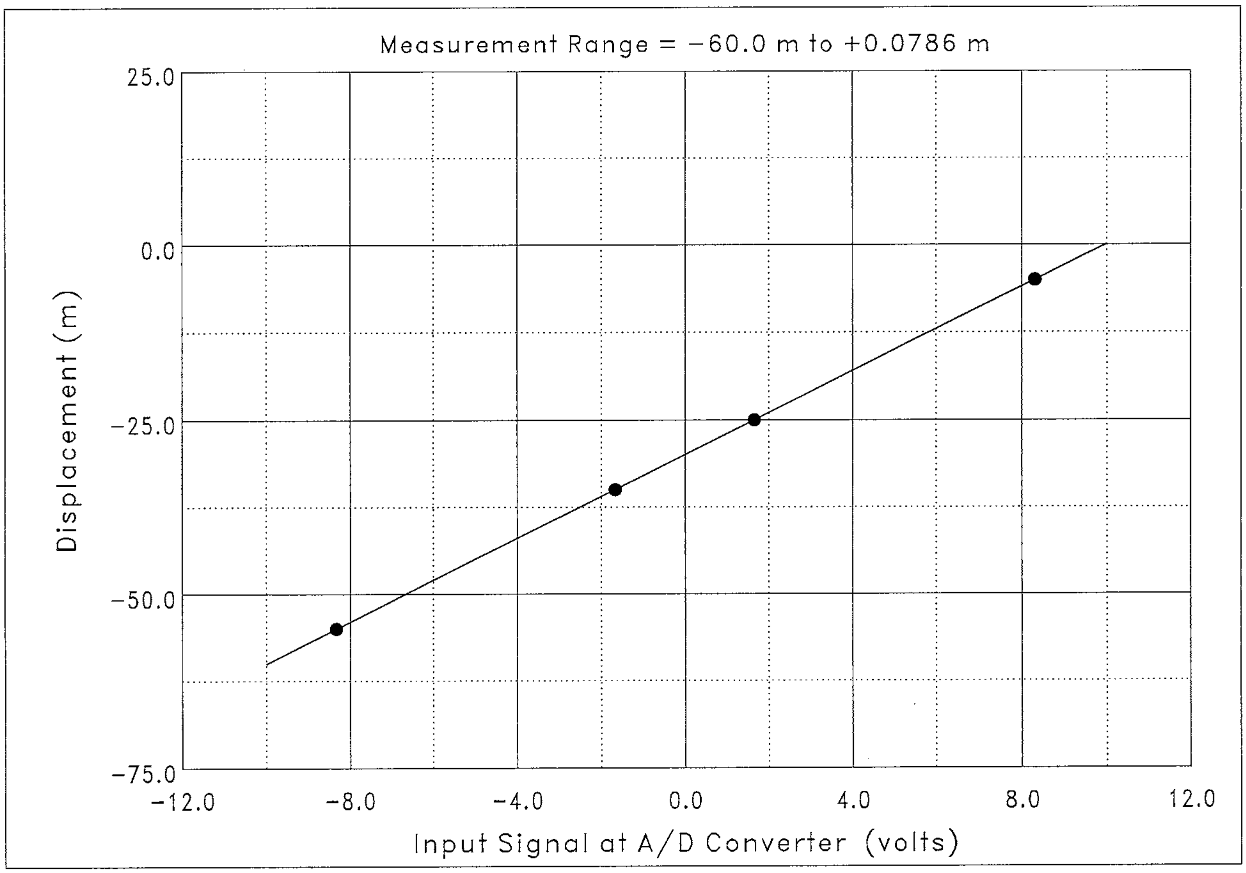
Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	8.310	−5.000	−5.000	0.00041008	
2	1.654	−25.000	−25.000	−0.00035477	
3	−1.674	−35.000	−35.000	−0.00048828	⇐ Maximum Error
4	−8.329	−55.000	−55.000	0.00043488	
Maximum Error = −0.000977 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −29.9709 m,
and C_1 = 3.00495 m/volt.



Calibration of OEBDAS Channel 34 — 13:49 07 January 2005

Project: Fishing Vessel Safety

Facility: OEB

Sensor: Y

Model: QTMDaq

Serial Number: N/A

Programmable Gain: 1

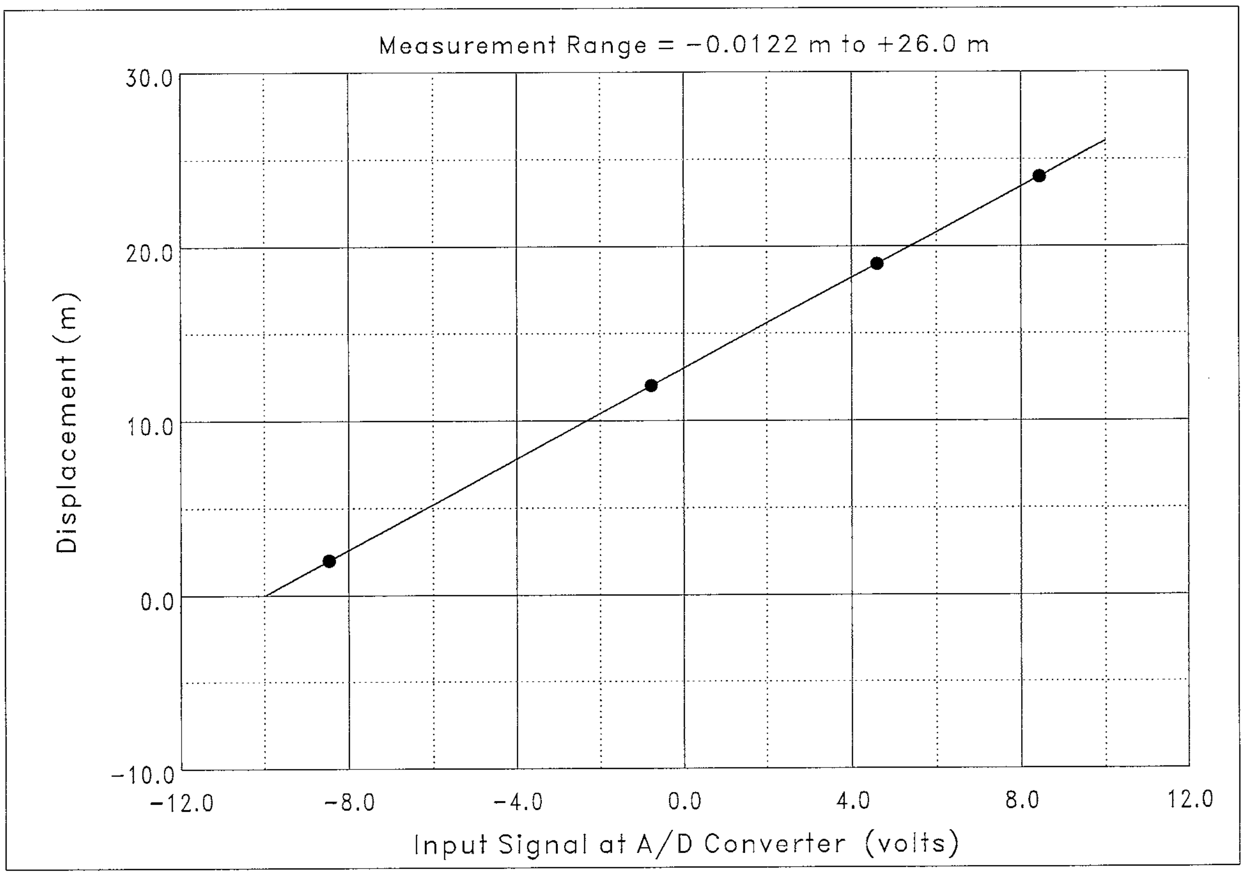
Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−8.455	2.000	2.000	0.00007439	
2	−0.775	12.000	12.000	−0.00036049	
3	4.601	19.000	19.001	0.00053787	⇐ Maximum Error
4	8.440	24.000	24.000	−0.00025177	
Maximum Error = 0.00244 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 13.0092 m,
and C_1 = 1.30215 m/volt .



Calibration of OEBDAS Channel 35 — 13:52 07 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Z **Model:** QTMDaq **Serial Number:** N/A

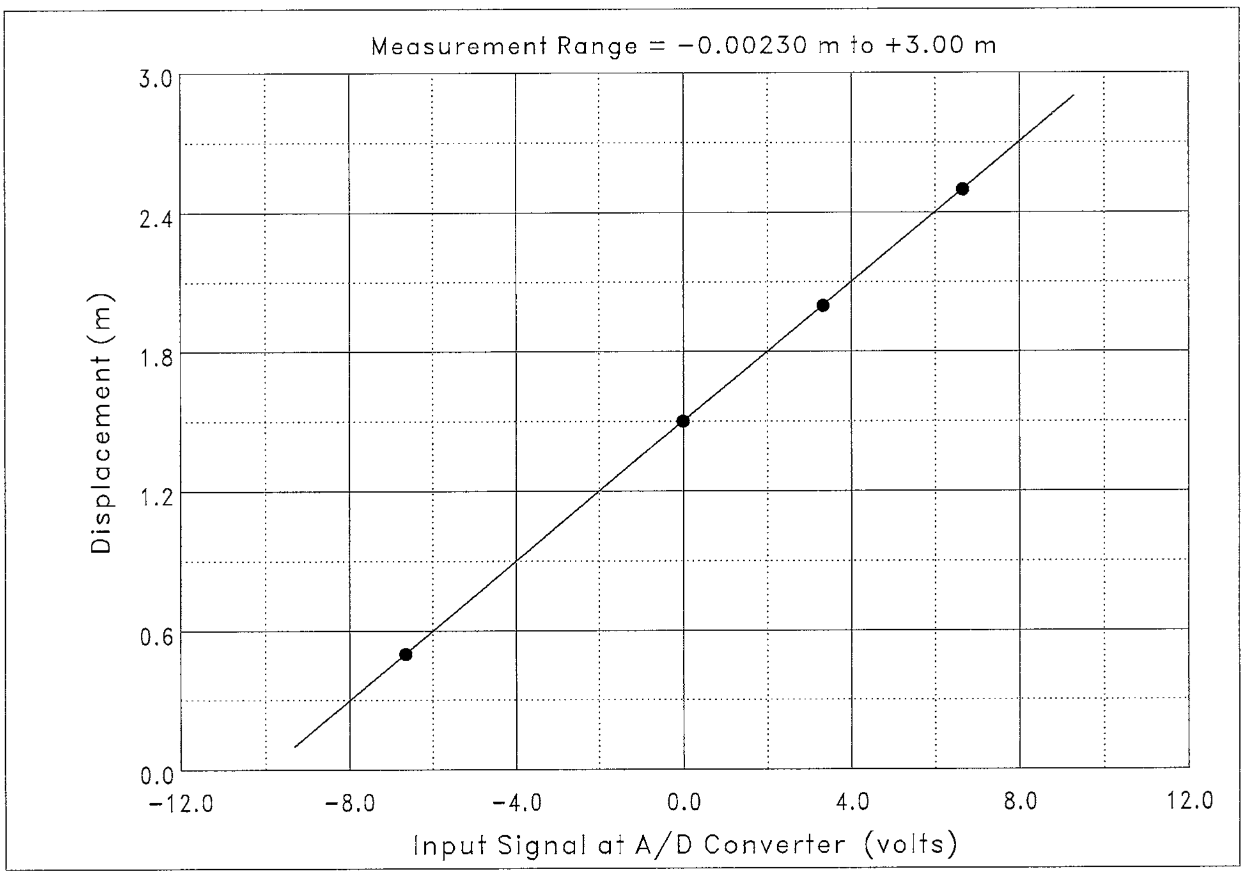
Programmable Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (m)	Fitted Curve Value (m)	Error (m)	
1	−6.659	0.5000	0.5000	$-0.22650E-05$	
2	−0.007	1.5000	1.5000	$0.61989E-05$	⇐ Maximum Error
3	3.319	2.0000	2.0000	$-0.34571E-05$	
4	6.645	2.5000	2.5000	$-0.47684E-06$	
Maximum Error = 0.000310 % of Calibration Range.					

Definition of Calibration Curve
Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),
$V(t)$ = input signal at A/D converter (volts),
C_0 = 1.50104 m,
and C_1 = 0.150334 m/volt.



Calibration of OEBDAS Channel 36	13:55 07 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Roll **Model:** QTMDaq **Serial Number:** N/A

Programmable Gain: 1

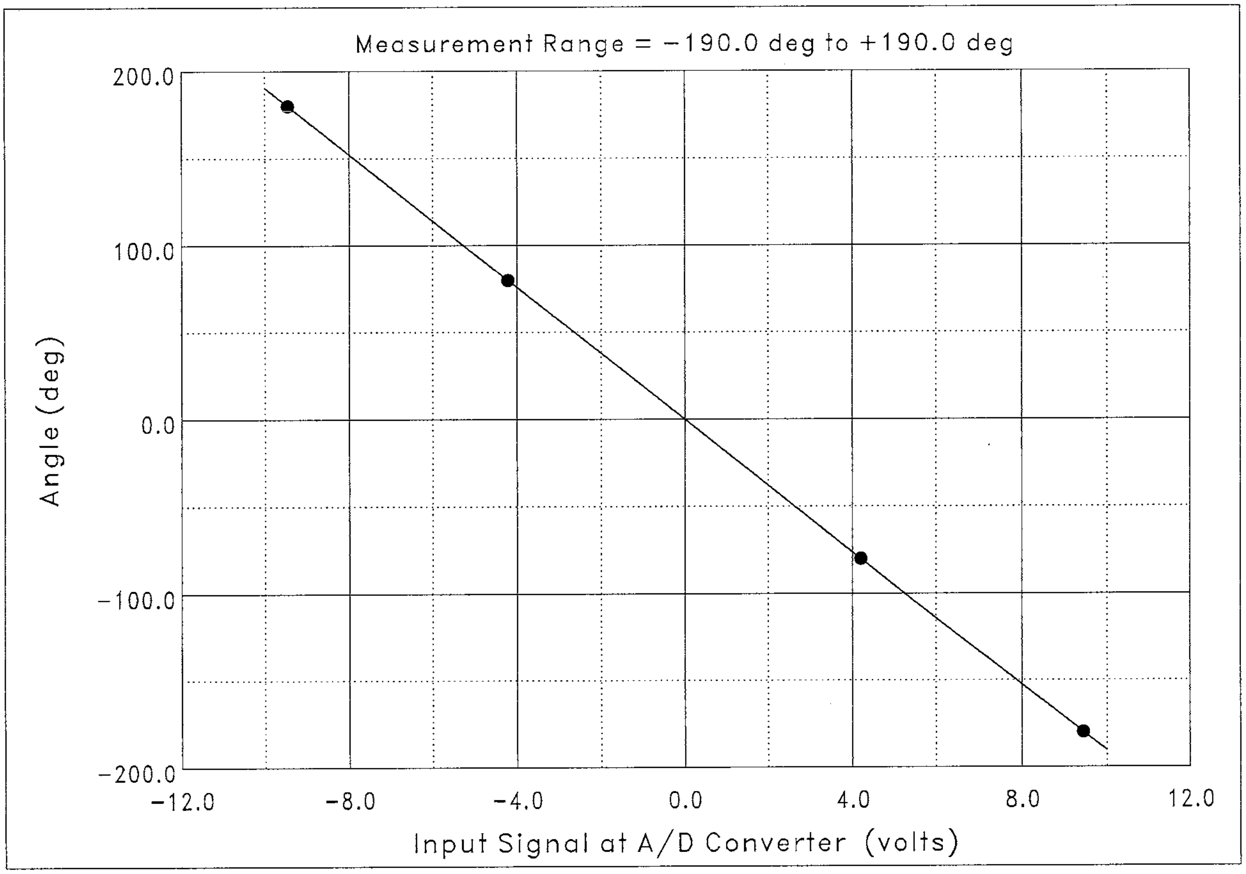
Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	9.449	−180.00	−180.00	−0.004333	
2	4.196	−80.00	−80.00	0.000320	
3	−4.209	80.00	80.01	0.014786	⇐ Maximum Error
4	−9.460	180.00	179.99	−0.010773	
Maximum Error = 0.00411 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),
$V(t)$ = input signal at A/D converter (volts),
C_0 = −0.115036 deg,
and C_1 = −19.0380 deg/volt .



Calibration of OEBDAS Channel 37 13:55 07 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Pitch **Model:** QTMDaq **Serial Number:** N/A

Programmable Gain: 1

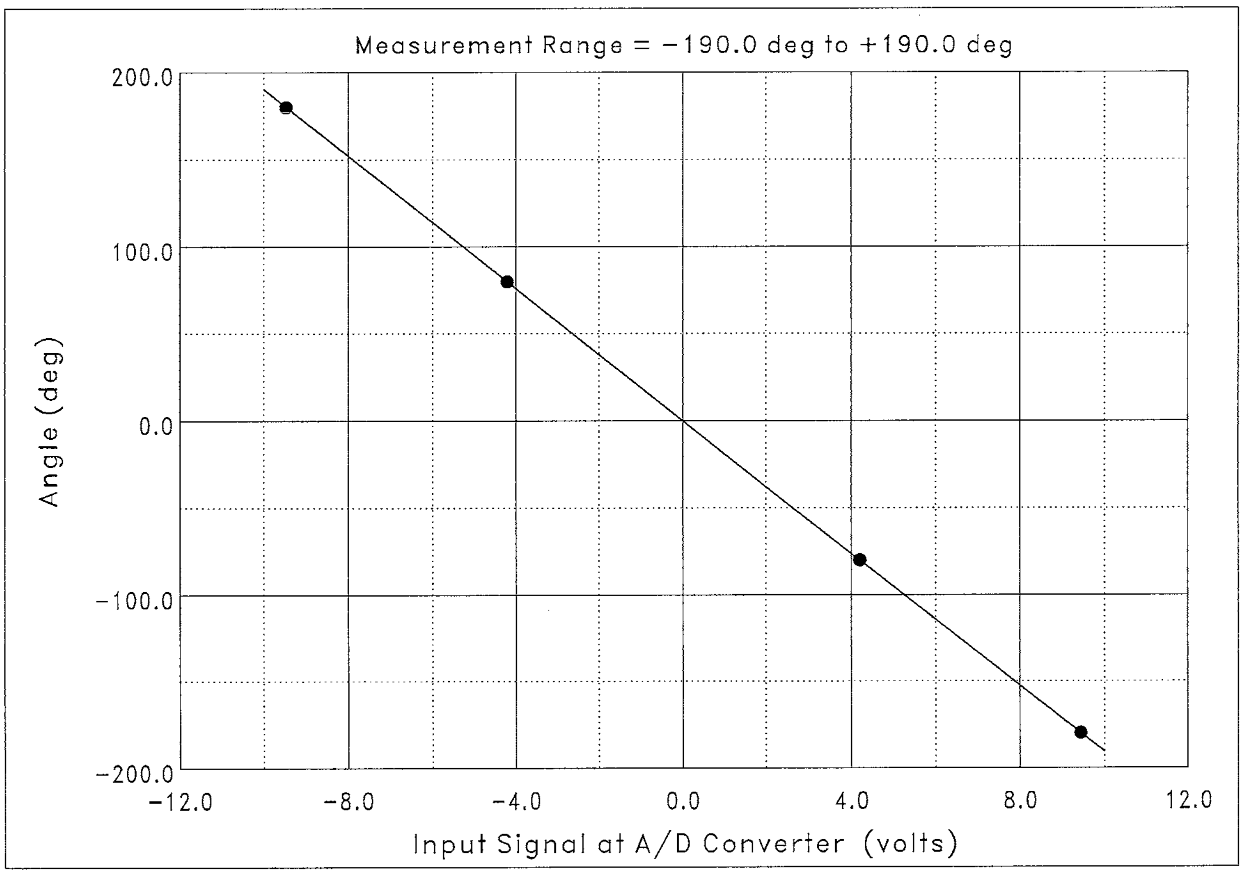
Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	9.449	−180.00	−180.00	−0.001480	
2	4.195	−80.00	−80.00	−0.002167	
3	−4.211	80.00	80.01	0.010971	⇐ Maximum Error
4	−9.464	180.00	179.99	−0.007324	
Maximum Error = 0.00305 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),
$V(t)$ = input signal at A/D converter (volts),
C_0 = -0.146205 deg,
and C_1 = -19.0341 deg/volt.



Calibration of OEBDAS Channel 38 13:55 07 January 2005

Project: Fishing Vessel Safety **Facility:** OEB

Sensor: Heading **Model:** QTMDaq **Serial Number:** N/A

Programmable Gain: 1

Data Point No.	Input Signal (volts)	Physical Value (deg)	Fitted Curve Value (deg)	Error (deg)	
1	9.446	−180.00	−180.00	−0.003723	
2	4.193	−80.00	−80.00	0.000557	
3	−4.212	80.00	80.01	0.011894	⇐ Maximum Error
4	−9.464	180.00	179.99	−0.008743	
Maximum Error = 0.00330 % of Calibration Range.					

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

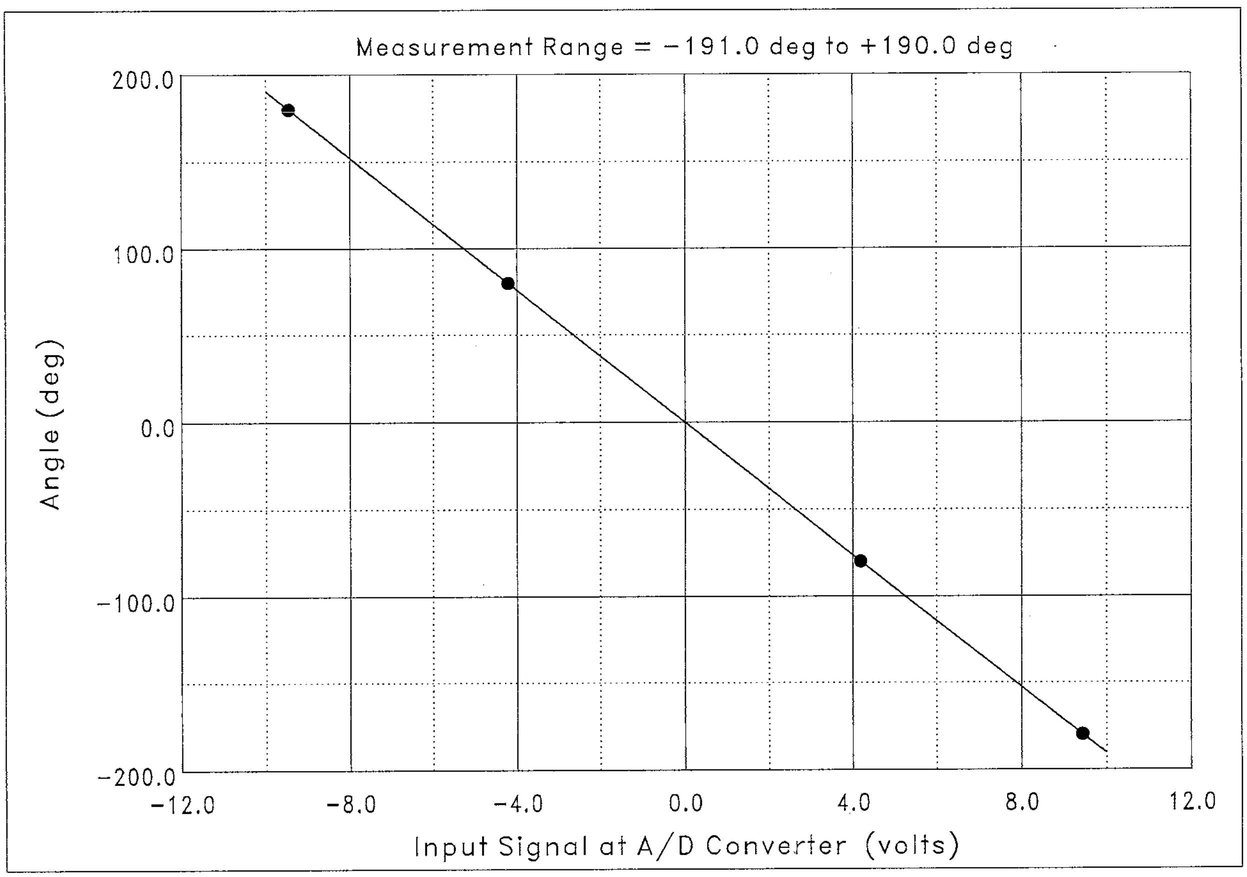
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),

$V(t)$ = input signal at A/D converter (volts),

C_0 = −0.174660 deg,

and C_1 = −19.0371 deg/volt .



APPENDIX D: FULL SCALE WAVE DATA / WAVE MATCHING RESULTS

NSI-Neptune Sciences, Inc - Wave Sentry Data Processing Software Version 1.23
Sat Oct 4 08:00:00 2003 **WAVE #1**
VBat = 11.73, Leak = DRY, Temp = 12.2

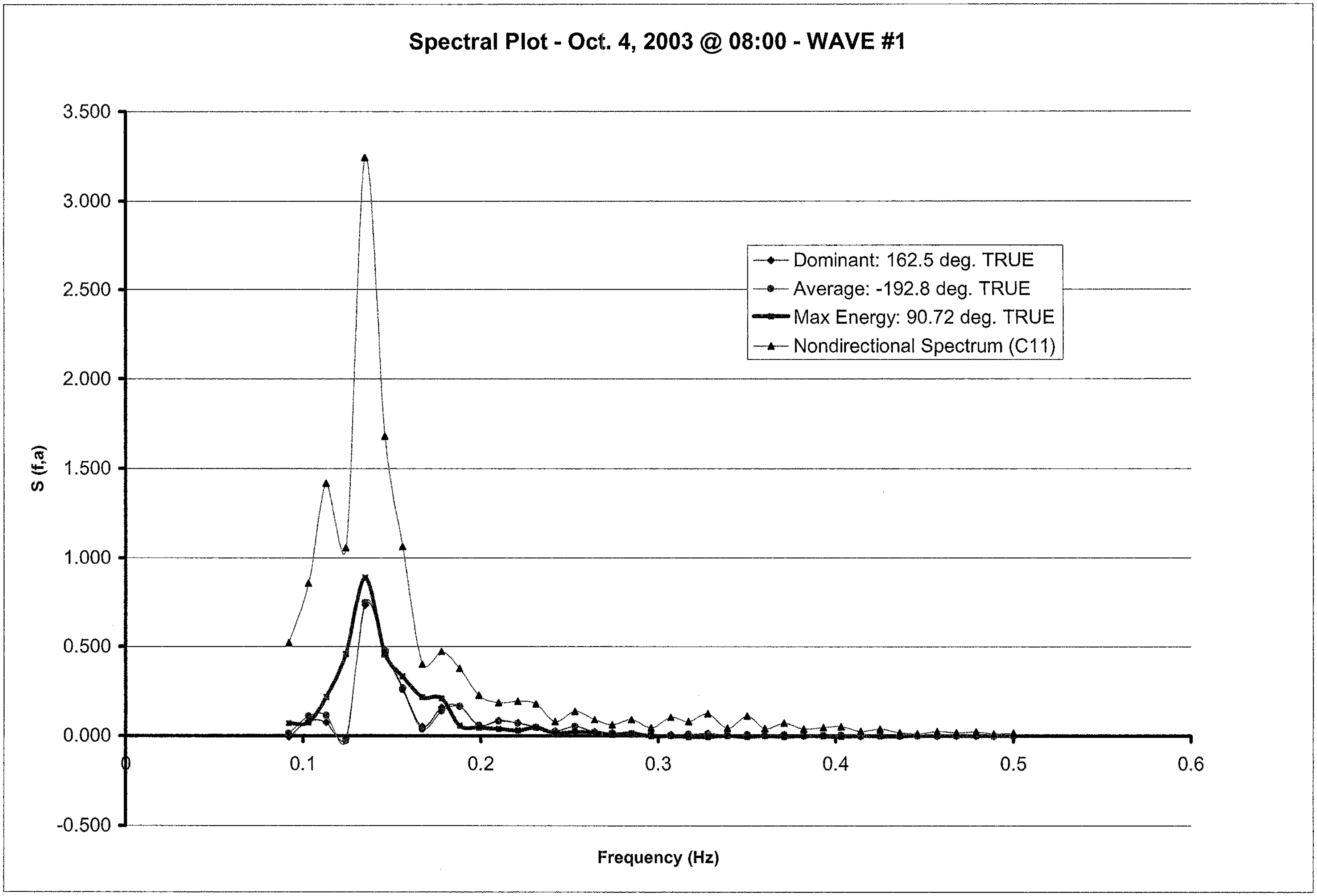
Significant wave height	=	1.51 m	
Dominant and average frequency	=	0.13 Hz	0.18 Hz
Dominant and average period	=	7.42 s	5.68 s

Wave directions are compass headings from which waves approach.			Correction	
Dominant wave direction	=	183.6 deg magnetic	-21.1	162.5 deg TRUE
Average wave direction	=	-171.7 deg magnetic	(deg)	-192.8 deg TRUE

bnd	cfrq (Hz)	c11 (m^2/Hz)	r1	r2	alpha1 (deg. mag.)	alpha2 (deg. mag.)	alpha1 (deg. TRUE)	alpha2 (deg. TRUE)
1	0.038	0	999.9	999.9	999.9	999.9		
2	0.049	0	999.9	999.9	999.9	999.9		
3	0.06	0	999.9	999.9	999.9	999.9		
4	0.07	0	999.9	999.9	999.9	999.9		
5	0.081	0	999.9	999.9	999.9	999.9		
6	0.092	0.5189	0.463	0.8406	252.5	256.7	231.4	235.6
7	0.103	0.8556	0.594	0.6058	244.6	255.6	223.5	234.5
8	0.113	1.4163	0.5423	0.6696	242.4	261.8	221.3	240.7
9	0.124	1.0563	0.5293	0.4777	86.1	93.4	65	72.3
10	0.135	3.2424	0.5138	0.3147	183.6	266.4	162.5	245.3
11	0.146	1.6807	0.5729	0.1852	183.4	103.8	162.3	82.7
12	0.156	1.0641	0.5111	0.2537	174.7	110	153.6	88.9
13	0.167	0.3996	0.5844	0.681	133.1	117.2	112	96.1
14	0.178	0.4704	0.6947	0.5766	147.2	138.8	126.1	117.7
15	0.188	0.3769	0.6322	0.2515	182.9	190.3	161.8	169.2
16	0.199	0.2258	0.5081	0.2803	190.6	252.2	169.5	231.1
17	0.21	0.1848	0.6334	0.4181	174.7	164.2	153.6	143.1
18	0.221	0.1936	0.5676	0.208	201.2	158.2	180.1	137.1
19	0.231	0.1776	0.4714	0.0845	170.3	106.5	149.2	85.4
20	0.242	0.0793	0.4397	0.2311	187.6	152.2	166.5	131.1
21	0.253	0.1373	0.3681	0.4238	170.1	171.1	149	150
22	0.264	0.0895	0.3176	0.3104	199.6	136.7	178.5	115.6
23	0.274	0.0619	0.16	0.2676	224.1	171.3	203	150.2
24	0.285	0.091	0.2485	0.0966	34.7	163.3	13.6	142.2
25	0.296	0.0451	0.453	0.4166	331.8	1.6	310.7	-19.5
26	0.307	0.1034	0.6938	0.4407	352.7	347.6	331.6	326.5
27	0.317	0.0804	0.6649	0.551	0.4	7.7	-20.7	-13.4
28	0.328	0.1242	0.7795	0.7547	353.9	347.5	332.8	326.4
29	0.339	0.0425	0.648	0.4645	25.4	14.6	4.3	-6.5
30	0.35	0.1109	0.7928	0.4972	2.3	179	-18.8	157.9
31	0.36	0.0399	0.6821	0.3955	3.4	171.2	-17.7	150.1
32	0.371	0.0717	0.8157	0.613	19.2	14.1	-1.9	-7
33	0.382	0.0376	0.7027	0.4495	16.6	27.9	-4.5	6.8
34	0.393	0.0457	0.6764	0.3796	3.3	8.8	-17.8	-12.3
35	0.403	0.0513	0.8839	0.6852	17.1	19.3	-4	-1.8
36	0.414	0.0237	0.5978	0.0567	347.6	300.7	326.5	279.6
37	0.425	0.0373	0.8213	0.6333	8.3	3.4	-12.8	-17.7
38	0.436	0.0173	0.7095	0.3685	350.4	4.7	329.3	-16.4
39	0.446	0.0121	0.6328	0.4828	347.3	338.5	326.2	317.4
40	0.457	0.0251	0.7528	0.4815	356.6	347.7	335.5	326.6
41	0.468	0.0182	0.6872	0.4443	341.1	341.9	320	320.8
42	0.479	0.0223	0.7312	0.3444	5.1	175.9	-16	154.8
43	0.489	0.0126	0.6143	0.1668	2.9	127.4	-18.2	106.3
44	0.5	0.0157	0.6427	0.1776	14.7	162.3	-6.4	141.2

Mean, min, max acc (g)	=	0.02	-0.42	0.51
Mean, min, max pitch (deg)	=	0	-17.4	16.8
Mean, min, max roll (deg)	=	0	-17.5	17.1
Maximum tilt (deg)	=	18.8		

NOTE: The magnetic deviation during the trials time frame was 21.1 deg. West.


Spectral Plot - Oct. 4, 2003 @ 08:00 - WAVE #1
Dominant: 162.5 deg. TRUE
Average: -192.8 deg. TRUE
Max Energy: 90.72 deg. TRUE
Nondirectional Spectrum (C11)
S (f,a)
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
-0.500
0
0.1
0.2
0.3
0.4
0.5
0.6
Frequency (Hz)

NSI-Neptune Sciences, Inc - Wave Sentry Data Processing Software Version 1.23

Sat Oct 4 09:30:00 2003

VBat = 11.70, Leak = DRY, Temp = 12.2 **WAVE #2**

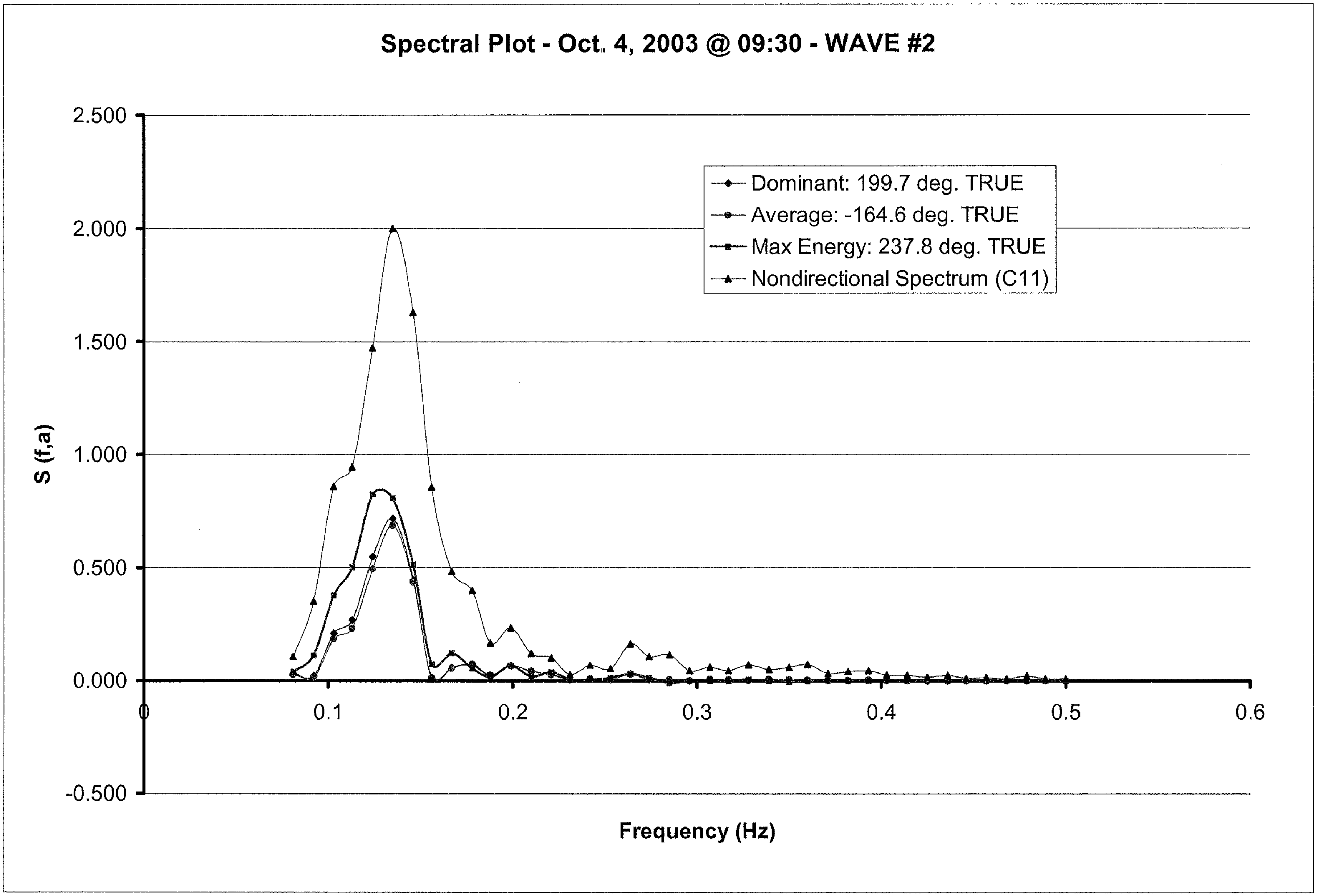
Significant wave height	=	1.37 m	
Dominant and average frequency	=	0.13 Hz	0.17 Hz
Dominant and average period	=	7.42 s	5.79 s

Wave directions are compass headings from which waves approach.			Correction	
Dominant wave direction	=	220.8 deg magnetic	-21.1	199.7 deg TRUE
Average wave direction	=	-143.5 deg magnetic	(deg)	-164.6 deg TRUE

bnd	cfrq (Hz)	c11 (m^2/Hz)	r1	r2	alpha1 (deg. mag.)	alpha2 (deg. mag.)	alpha1 (deg. TRUE)	alpha2 (deg. TRUE)
1	0.038	0	999.9	999.9	999.9	999.9		
2	0.049	0	999.9	999.9	999.9	999.9		
3	0.06	0	999.9	999.9	999.9	999.9		
4	0.07	0	999.9	999.9	999.9	999.9		
5	0.081	0.1076	0.2738	0.4941	206.4	259.1	185.3	238
6	0.092	0.3531	0.2934	0.6147	270.2	292.8	249.1	271.7
7	0.103	0.8595	0.4169	0.5851	230.2	272.7	209.1	251.6
8	0.113	0.9447	0.5421	0.6618	256.2	267.6	235.1	246.5
9	0.124	1.4714	0.6611	0.622	246.1	262.3	225	241.2
10	0.135	2.001	0.593	0.3038	220.8	262.7	199.7	241.6
11	0.146	1.6296	0.5464	0.2603	207.8	286.4	186.7	265.3
12	0.156	0.856	0.5559	0.653	147.6	125	126.5	103.9
13	0.167	0.4834	0.381	0.5309	180.4	111.1	159.3	90
14	0.178	0.4003	0.563	0.2785	165.7	127.5	144.6	106.4
15	0.188	0.1682	0.5823	0.3384	157.1	130.6	136	109.5
16	0.199	0.2351	0.5208	0.2127	192.3	273.8	171.2	252.7
17	0.21	0.1213	0.5018	0.4279	217.7	179.5	196.6	158.4
18	0.221	0.1011	0.4598	0.4795	206.7	272	185.6	250.9
19	0.231	0.0264	0.2581	0.2286	282.1	287.8	261	266.7
20	0.242	0.0688	0.4095	0.2792	145.3	140.6	124.2	119.5
21	0.253	0.0531	0.1409	0.4408	204.8	291.9	183.7	270.8
22	0.264	0.1642	0.2157	0.2603	122.7	74	101.6	52.9
23	0.274	0.1074	0.3707	0.0907	358.7	314.4	337.6	293.3
24	0.285	0.1157	0.3146	0.5539	31.7	169	10.6	147.9
25	0.296	0.0449	0.5167	0.387	354.3	337.9	333.2	316.8
26	0.307	0.0596	0.3441	0.3431	43.5	6.6	22.4	-14.5
27	0.317	0.0449	0.5426	0.4618	15.9	17.7	-5.2	-3.4
28	0.328	0.0699	0.5018	0.1604	47.7	74.8	26.6	53.7
29	0.339	0.0496	0.6219	0.5295	28.4	29.1	7.3	8
30	0.35	0.0603	0.52	0.4959	31.6	5.3	10.5	-15.8
31	0.36	0.0721	0.5727	0.3646	18.8	6.6	-2.3	-14.5
32	0.371	0.0321	0.6521	0.312	49.5	49.7	28.4	28.6
33	0.382	0.0413	0.7183	0.3962	7.4	6.2	-13.7	-14.9
34	0.393	0.0437	0.6808	0.3915	45.5	42.8	24.4	21.7
35	0.403	0.0254	0.6749	0.3016	34.7	50.1	13.6	29
36	0.414	0.0229	0.6736	0.3399	22.8	13.5	1.7	-7.6
37	0.425	0.0148	0.5638	0.085	20.8	112.8	-0.3	91.7
38	0.436	0.0235	0.629	0.0534	43.6	75.5	22.5	54.4
39	0.446	0.0097	0.6191	0.1767	28.1	47.6	7	26.5
40	0.457	0.0134	0.6694	0.4706	11	177.5	-10.1	156.4
41	0.468	0.0078	0.5019	0.2029	32.4	127.2	11.3	106.1
42	0.479	0.0195	0.7603	0.4928	35.4	36.6	14.3	15.5
43	0.489	0.0076	0.5627	0.1356	45.2	77.5	24.1	56.4
44	0.5	0.0074	0.6726	0.2832	11.4	10.1	-9.7	-11

Mean, min, max acc (g)	=	0.02	-0.35	0.41
Mean, min, max pitch (deg)	=	0	-15.4	16.5
Mean, min, max roll (deg)	=	0	-18.8	13.9
Maximum tilt (deg)	=	19.8		

NOTE: The magnetic deviation during the trials time frame was 21.1 deg. West.


Spectral Plot - Oct. 4, 2003 @ 09:30 - WAVE #2
Dominant: 199.7 deg. TRUE
Average: -164.6 deg. TRUE
Max Energy: 237.8 deg. TRUE
Nondirectional Spectrum (C11)
S (f,a)
2.500
2.000
1.500
1.000
0.500
0.000
-0.500
0
0.1
0.2
0.3
0.4
0.5
0.6
Frequency (Hz)

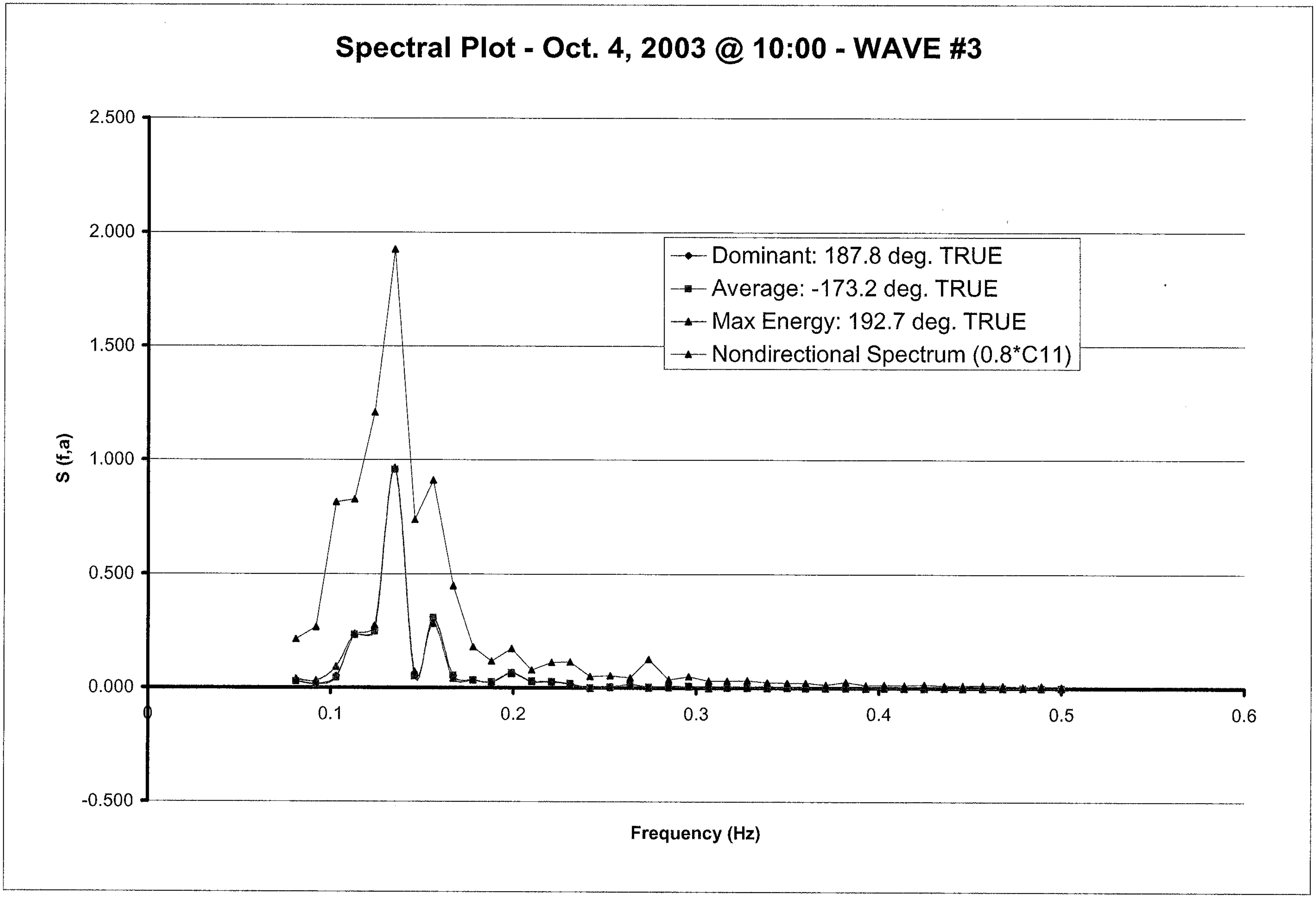
NSI-Neptune Sciences, Inc - Wave Sentry Data Processing Software Version 1.23
Sat Oct 4 10:00:00 2003 **WAVE #3**
VBat = 11.67, Leak = DRY, Temp = 12.2

Significant wave height	=	1.38 m			
Significant wave height with wave amplitude reduced by 20% = 1.245 m					
Dominant and average frequency	=	0.13 Hz		0.16 Hz	
Dominant and average period	=	7.42 s		6.11 s	
Wave directions are compass headings from which waves approach.			Correction		
Dominant wave direction	=	208.9 deg magnetic	-21.1		187.8 deg TRUE
Average wave direction	=	-152.1 deg magnetic	(deg)		-173.2 deg TRUE

bnd	cfrq (Hz)	c11 (m^2/Hz)	0.8*c11 (m^2/Hz)	r1	r2	alpha1 (deg. mag.)	alpha2 (deg. mag.)	alpha1 (deg. TRUE)	alpha2 (deg. TRUE)
1	0.038	0	0	999.9	999.9	999.9	999.9		
2	0.049	0	0	999.9	999.9	999.9	999.9		
3	0.06	0	0	999.9	999.9	999.9	999.9		
4	0.07	0	0	999.9	999.9	999.9	999.9		
5	0.081	0.2681	0.21448	0.4606	0.4897	286	263.8	264.9	242.7
6	0.092	0.3348	0.26784	0.5542	0.7774	277.1	273.5	256	252.4
7	0.103	1.0159	0.81272	0.5123	0.8588	268.5	274.1	247.4	253
8	0.113	1.031	0.8248	0.522	0.164	209.2	280.9	188.1	259.8
9	0.124	1.5101	1.20808	0.3454	0.3886	202.4	268.2	181.3	247.1
10	0.135	2.4074	1.92592	0.7623	0.3132	208.9	216.8	187.8	195.7
11	0.146	0.9178	0.73424	0.3293	0.6835	213.9	284.1	192.8	263
12	0.156	1.1371	0.90968	0.6768	0.2648	182.2	158.1	161.1	137
13	0.167	0.5598	0.44784	0.5178	0.5787	159.6	137.4	138.5	116.3
14	0.178	0.2237	0.17896	0.482	0.3219	166	98.7	144.9	77.6
15	0.188	0.1459	0.11672	0.5865	0.3193	168.6	140.9	147.5	119.8
16	0.199	0.2161	0.17288	0.6682	0.0969	184.5	206.7	163.4	185.6
17	0.21	0.098	0.0784	0.5765	0.2654	168.4	192.8	147.3	171.7
18	0.221	0.1397	0.11176	0.586	0.1934	164.4	141.3	143.3	120.2
19	0.231	0.1426	0.11408	0.443	0.4659	150.9	151.2	129.8	130.1
20	0.242	0.064	0.0512	0.3686	0.7463	146.5	132	125.4	110.9
21	0.253	0.0665	0.0532	0.2082	0.3099	63.5	156.3	42.4	135.2
22	0.264	0.0564	0.04512	0.4378	0.2386	226.8	210.6	205.7	189.5
23	0.274	0.1576	0.12608	0.4809	0.303	354.1	341.9	333	320.8
24	0.285	0.0467	0.03736	0.5657	0.3259	11.1	22.3	-10	1.2
25	0.296	0.0635	0.0508	0.5007	0.484	46.1	26.4	25	5.3
26	0.307	0.0387	0.03096	0.2977	0.6076	352	327.6	330.9	306.5
27	0.317	0.04	0.032	0.5237	0.3117	10.4	5.2	-10.7	-15.9
28	0.328	0.0407	0.03256	0.6493	0.5517	30.3	10.3	9.2	-10.8
29	0.339	0.0316	0.02528	0.6984	0.3557	16.3	10	-4.8	-11.1
30	0.35	0.0285	0.0228	0.5085	0.4098	25.3	17.5	4.2	-3.6
31	0.36	0.0288	0.02304	0.6176	0.5759	25.5	3.4	4.4	-17.7
32	0.371	0.018	0.0144	0.3899	0.2424	113.8	114.2	92.7	93.1
33	0.382	0.032	0.0256	0.6511	0.4794	28.2	8.7	7.1	-12.4
34	0.393	0.0164	0.01312	0.5631	0.3803	20.1	160.1	-1	139
35	0.403	0.0175	0.014	0.7458	0.6738	7.2	178.3	-13.9	157.2
36	0.414	0.0161	0.01288	0.4863	0.1548	19.6	141.3	-1.5	120.2
37	0.425	0.0211	0.01688	0.594	0.3973	24	171	2.9	149.9
38	0.436	0.0129	0.01032	0.6017	0.4762	9.2	1.9	-11.9	-19.2
39	0.446	0.0129	0.01032	0.5919	0.2537	18	155.4	-3.1	134.3
40	0.457	0.0153	0.01224	0.5941	0.3434	19.6	168	-1.5	146.9
41	0.468	0.0132	0.01056	0.7089	0.3395	24.6	16.2	3.5	-4.9
42	0.479	0.0067	0.00536	0.4872	0.0625	32.8	24.7	11.7	3.6
43	0.489	0.0113	0.00904	0.6681	0.2885	42.5	22	21.4	0.9
44	0.5	0.0064	0.00512	0.7307	0.4758	9.6	1.3	-11.5	-19.8
		11.0108	8.80864						

Mean, min, max acc (g)	=	0.02	-0.32	0.4
Mean, min, max pitch (deg)	=	0	-15.2	15.1
Mean, min, max roll (deg)	=	0	-13.5	13.9
Maximum tilt (deg)	=	15.5		

NOTE: The magnetic deviation during the trials time frame was 21.1 deg. West.

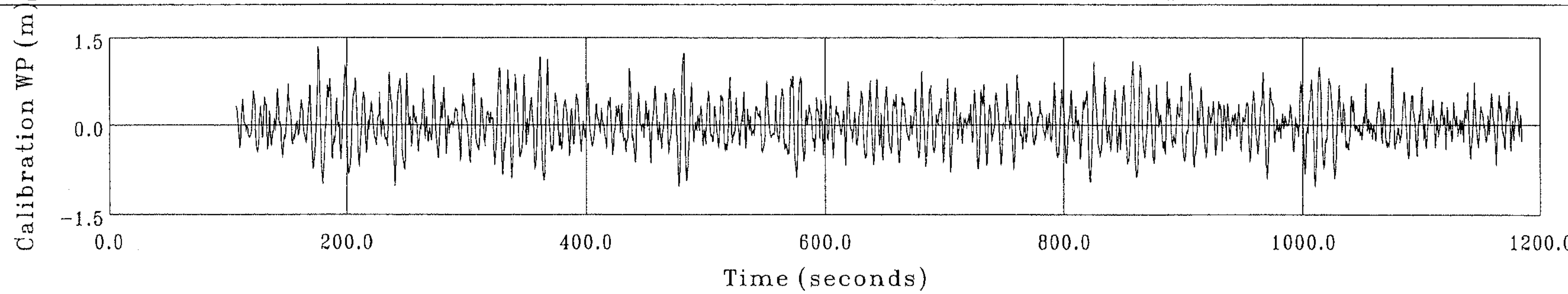


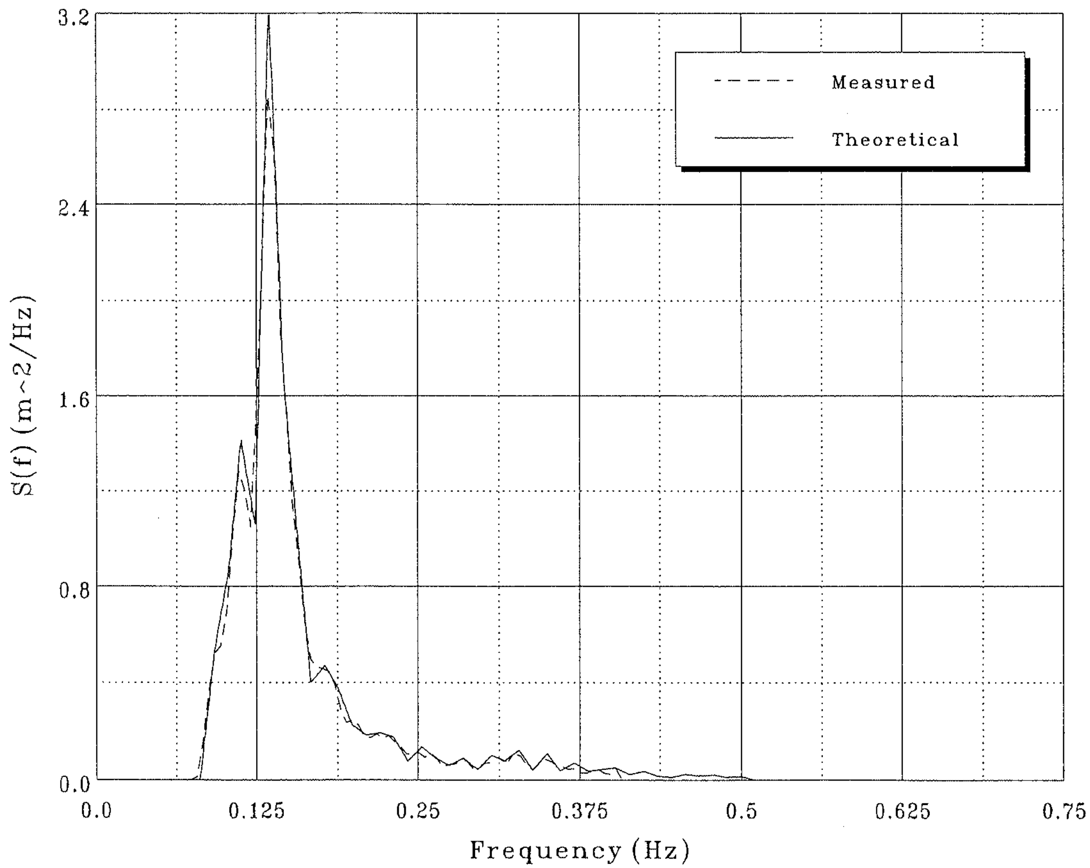
Spectral Plot - Oct. 4, 2003 @ 10:00 - WAVE #3
Dominant: 187.8 deg. TRUE
Average: -173.2 deg. TRUE
Max Energy: 192.7 deg. TRUE
Nondirectional Spectrum (0.8*C11)
S (f,a)
2.500
2.000
1.500
1.000
0.500
0.000
-0.500
0
0.1
0.2
0.3
0.4
0.5
0.6
Frequency (Hz)

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 12:34:05
Acquired: 4-NOV-2004 12:23:46





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 1.4730 m	
T_{pd}	= 7.3720 s	7.4200 s
m_0	= 0.1356	
m_2	= 0.0037	
T_Z	= 6.0730 s	
ε_4	= 0.6727	
DOF	= 22.00	
Deviation from target T_p	= 0.6469 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.4248 m	1.5100 m
Deviation from target H_s	= -5.641 %	(5.0 %)

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Institute for Ocean Technology

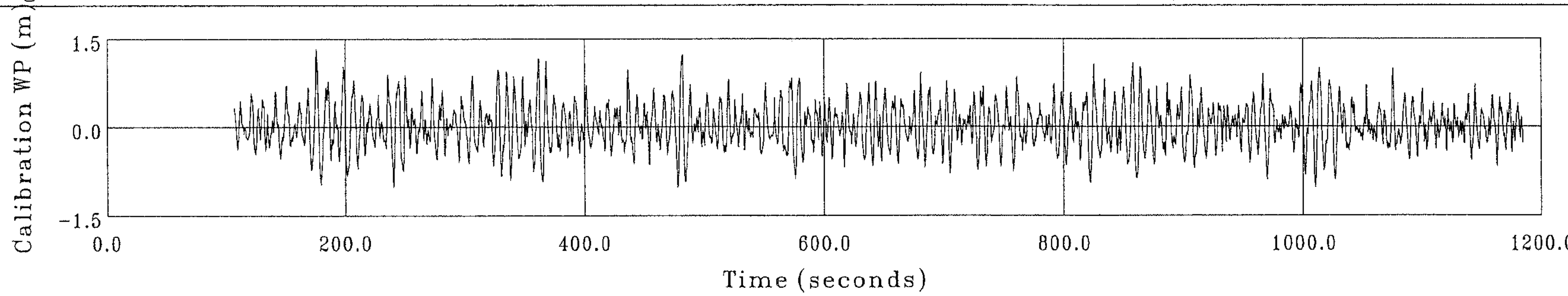
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

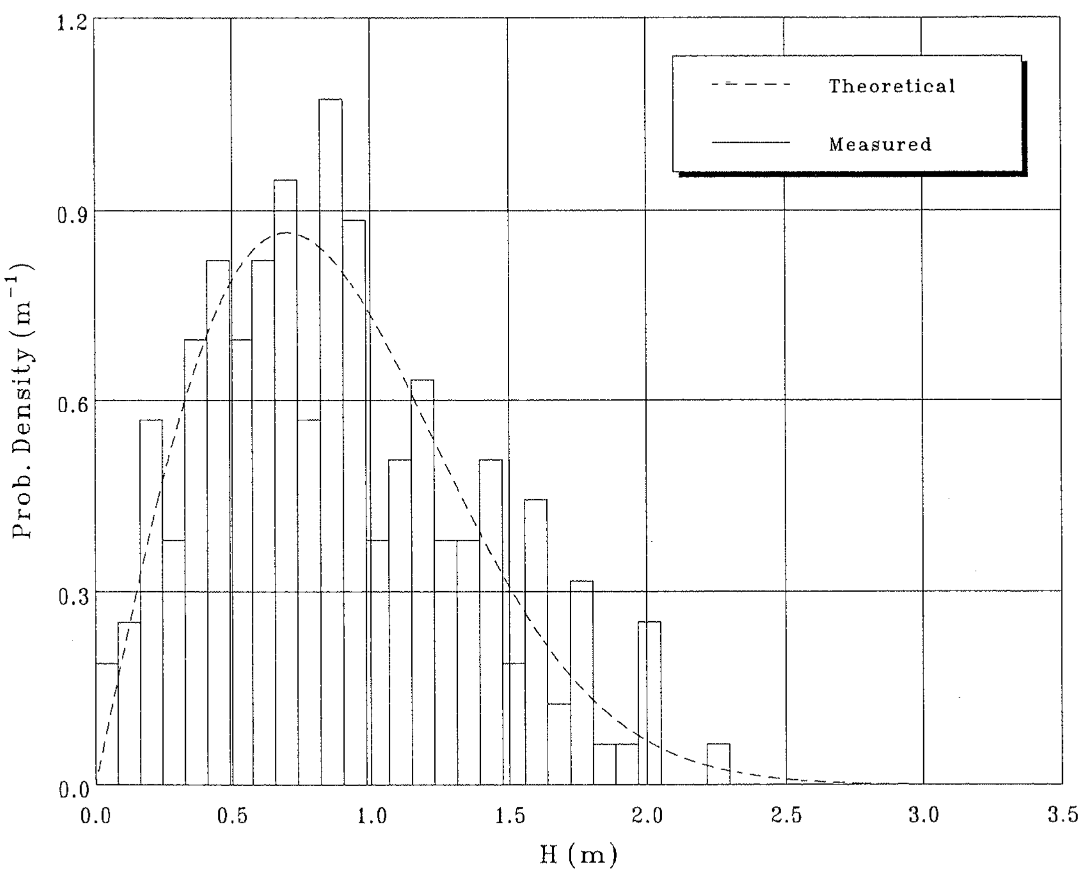
Figure A85 MUN25_WAVE1_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 12:34:05
Acquired: 4-NOV-2004 12:23:46





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	2.263 m	2.257 m
T_{Hmax}	8.354 s	7.405 s
$H_{1/3}$	1.412 m	1.438 m
$H_{1/10}$	1.791 m	1.798 m
$H_{1/100}$	2.211 m	2.153 m
AC_{Max}	1.322 m	

		Target
H_s	= 1.4248 m	1.5100 m
Deviation from target H_s	= -5.641 %	(5.0 %)

National Research Council Canada
Institute for Ocean Technology

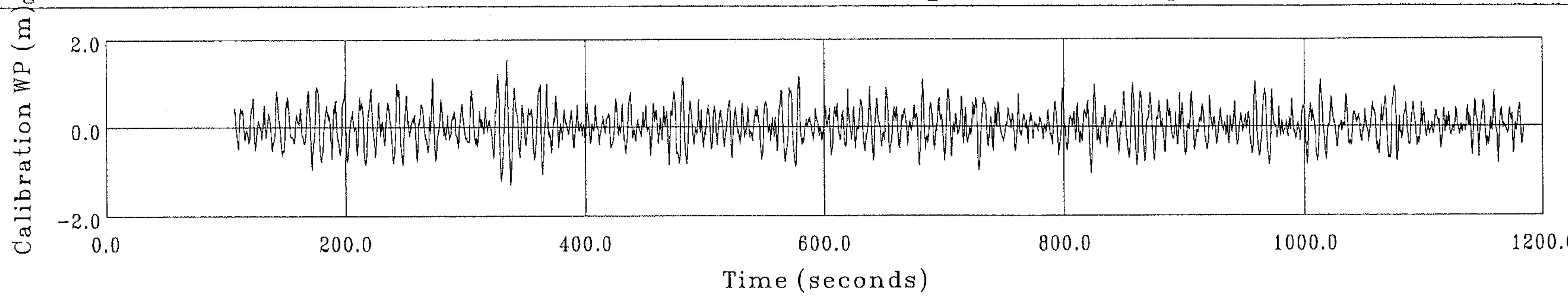
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

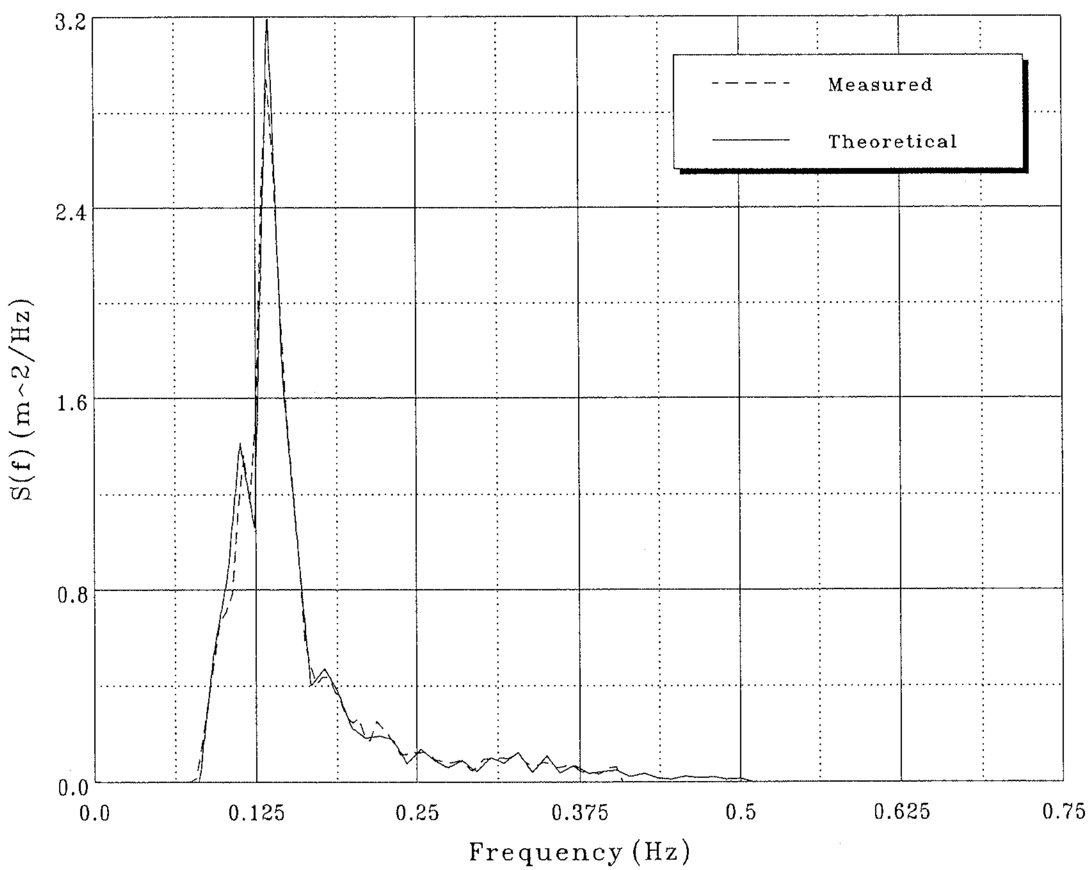
Figure A85 MUN25_WAVE1_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 13:12:54
Acquired: 4-NOV-2004 13:03:32





		TARGET / (TOLERANCE)
Spectral Analysis:		
Hm_0	= 1.5006 m	
T_{pd}	= 7.4041 s	7.4200 s
m_0	= 0.1407	
m_2	= 0.0040	
T_Z	= 5.9465 s	
ε_4	= 0.6800	
DOF	= 22.00	
Deviation from target T_p	= 0.2148 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.4540 m	1.5100 m
Deviation from target H_s	= −3.709 %	(5.0 %)

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Institute for Ocean Technology

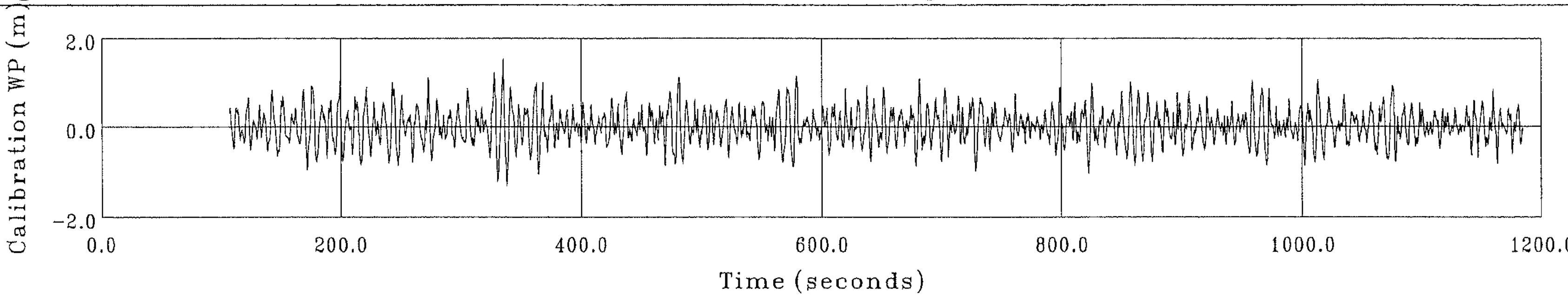
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

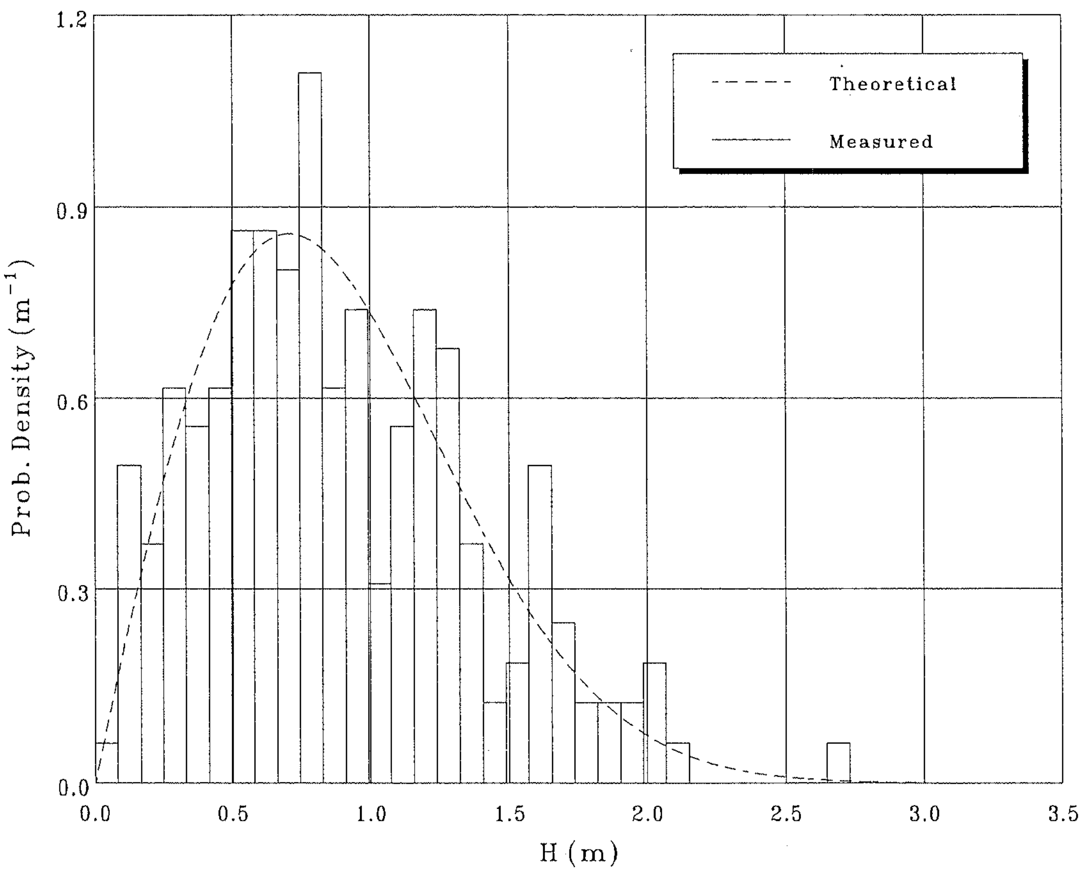
Figure A87 MUN25F_WAVE1_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 13:12:54
Acquired: 4-NOV-2004 13:03:32





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	2.777 m	2.677 m
T_{Hmax}	7.108 s	7.324 s
$H_{1/3}$	1.450 m	1.458 m
$H_{1/10}$	1.819 m	1.844 m
$H_{1/100}$	2.558 m	2.411 m
AC_{Max}	1.510 m	

		Target
H_s	= 1.4540 m	1.5100 m
Deviation from target H_s	= -3.709 %	(5.0 %)

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Institute for Ocean Technology

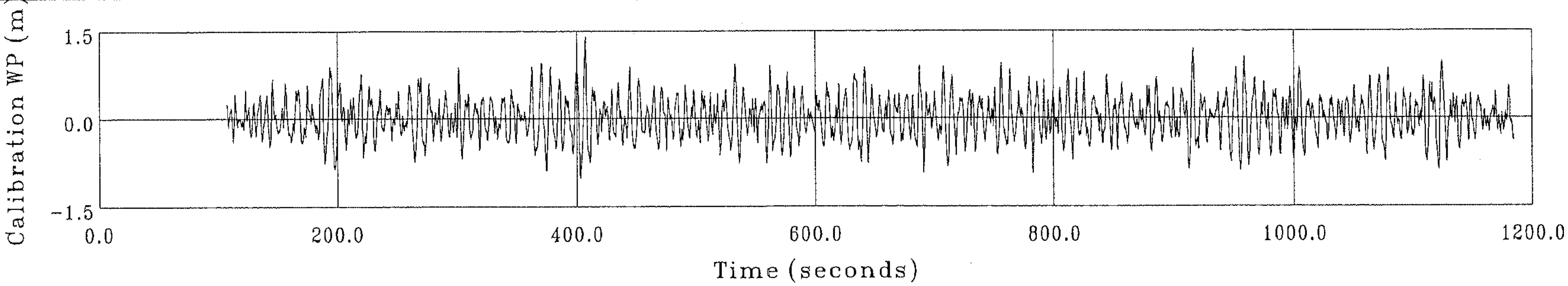
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

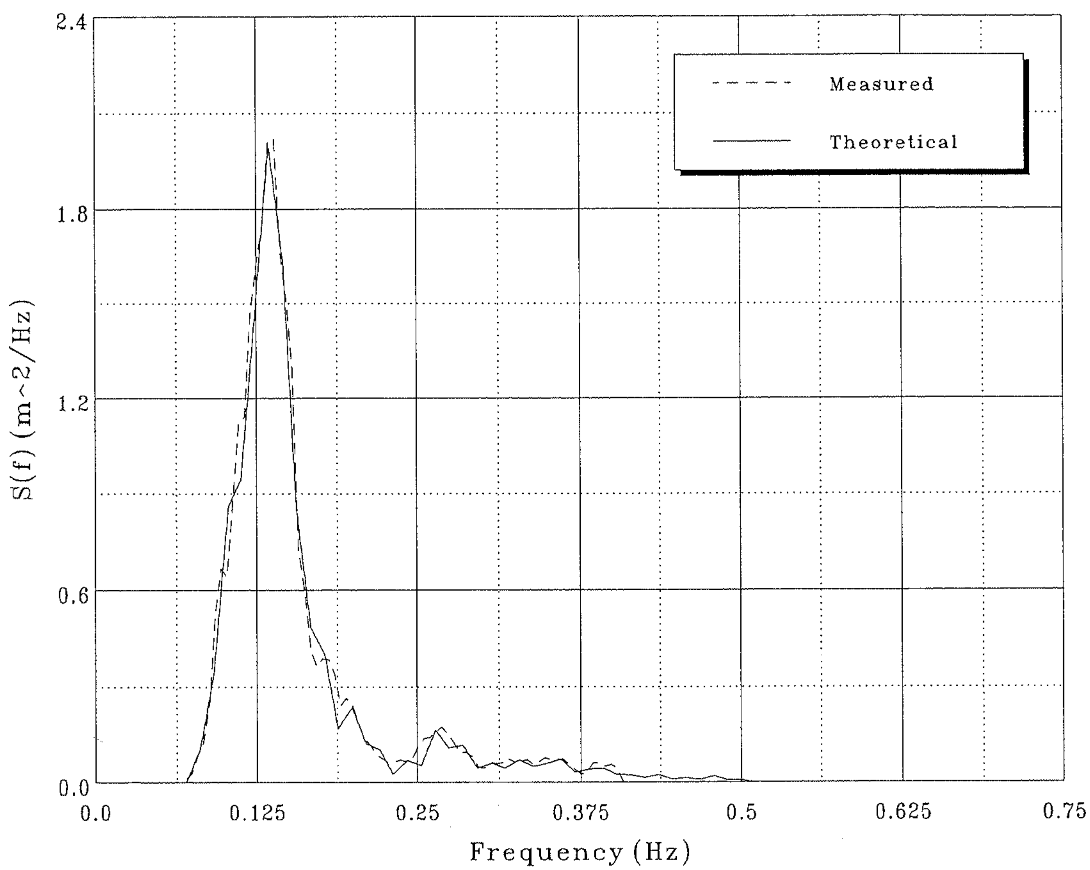
Figure A87 MUN25F_WAVE1_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 10:05:32
Acquired: 4-NOV-2004 09:55:19





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 1.3993 m	
T_{pd}	= 7.4033 s	7.4200 s
m_0	= 0.1224	
m_2	= 0.0034	
T_Z	= 5.9867 s	
ε_4	= 0.6905	
DOF	= 22.00	
Deviation from target T_p	= 0.2250 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.3373 m	1.3700 m
Deviation from target H_s	= -2.386 %	(5.0 %)

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Institute for Ocean Technology

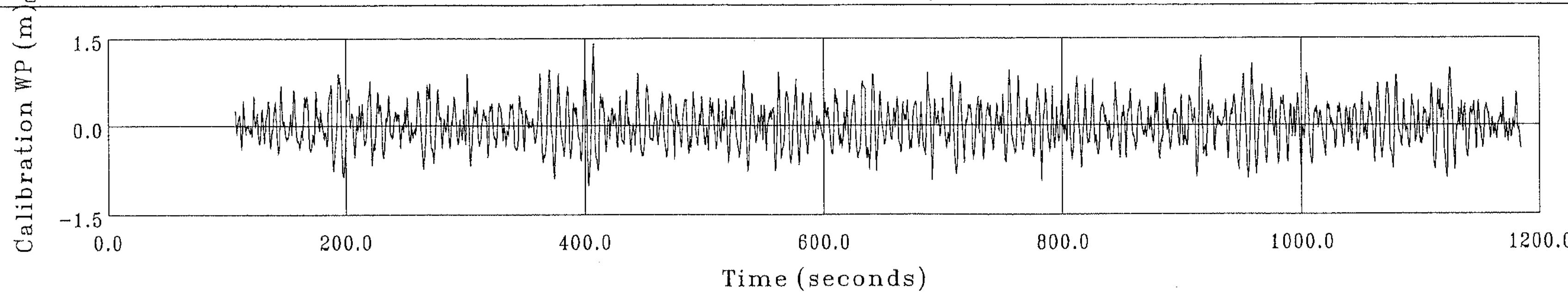
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

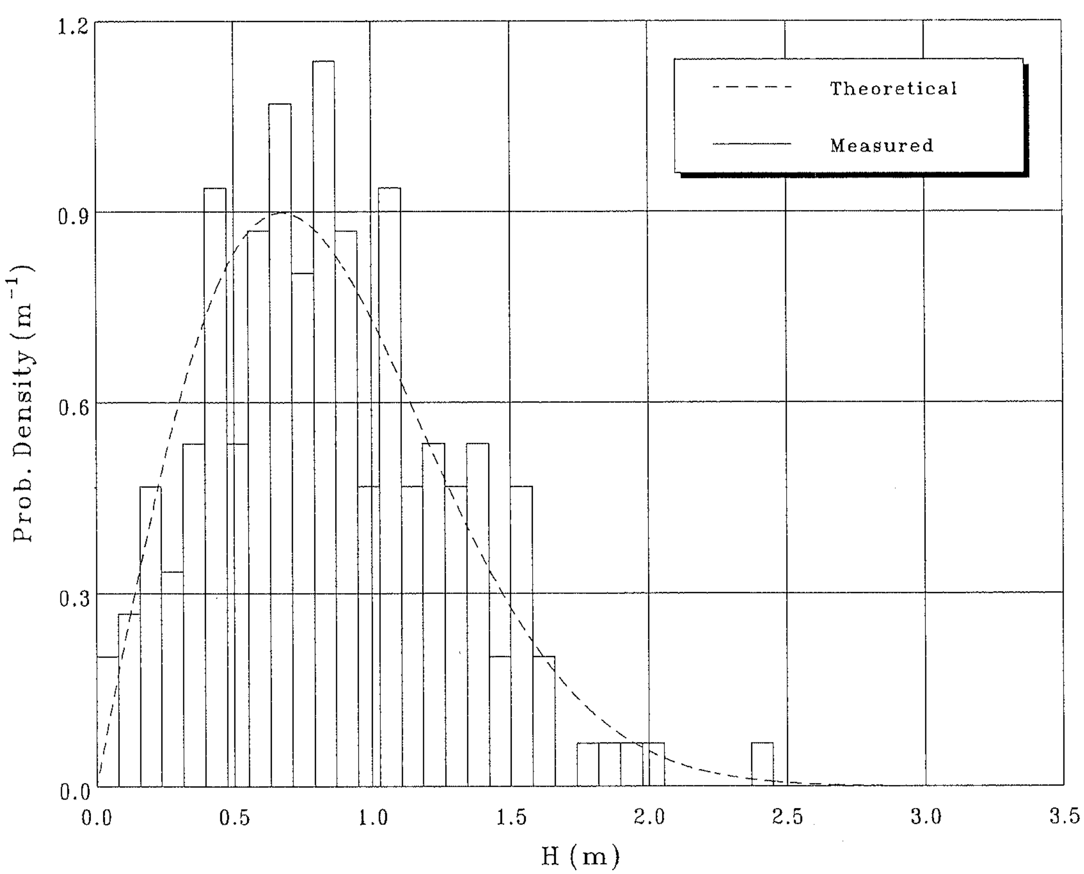
Figure A78 MUN25_WAVE2_007

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 10:05:32
Acquired: 4-NOV-2004 09:55:19





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	2.155 m	2.422 m
T_{Hmax}	6.795 s	6.797 s
$H_{1/3}$	1.339 m	1.336 m
$H_{1/10}$	1.686 m	1.657 m
$H_{1/100}$	2.005 m	2.222 m
AC_{Max}	1.412 m	

		Target
H_s	= 1.3373 m	1.3700 m
Deviation from target H_s	= -2.386 %	(5.0 %)

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Institute for Ocean Technology

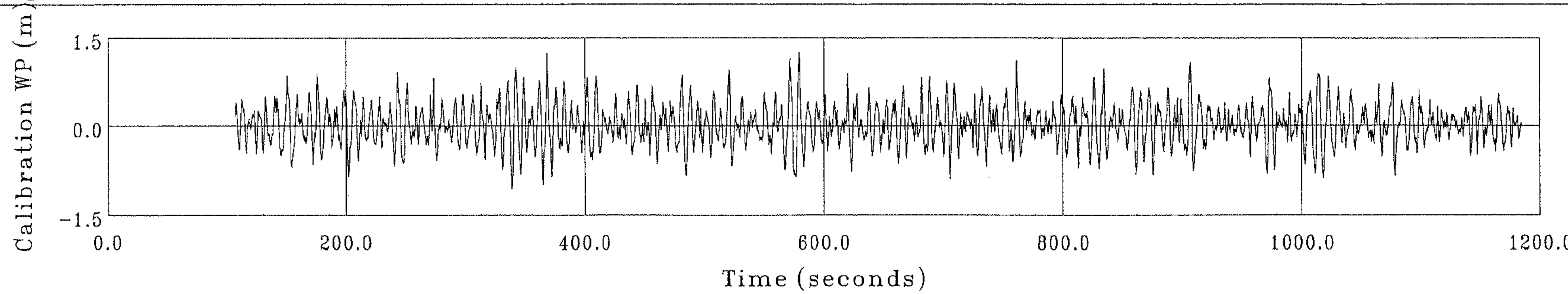
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

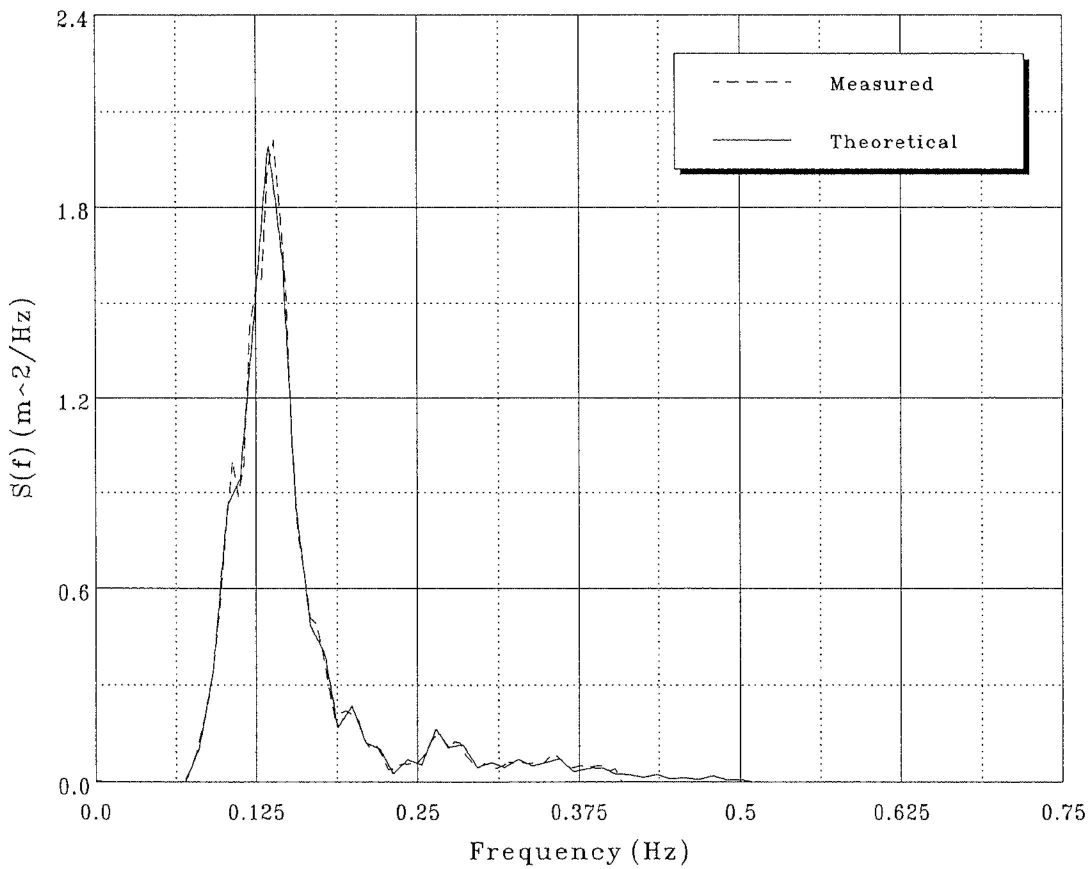
Figure A78 MUN25_WAVE2_007

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 11:05:30
Acquired: 4-NOV-2004 10:56:07





		TARGET / (TOLERANCE)
Spectral Analysis:		
Hm_0	= 1.3678 m	
T_{pd}	= 7.2092 s	7.4200 s
m_0	= 0.1169	
m_2	= 0.0032	
T_z	= 6.0392 s	
ε_4	= 0.6914	
DOF	= 22.00	
Deviation from target T_p	= 2.841 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.3322 m	1.3700 m
Deviation from target H_s	= -2.759 %	(5.0 %)

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Institute for Ocean Technology

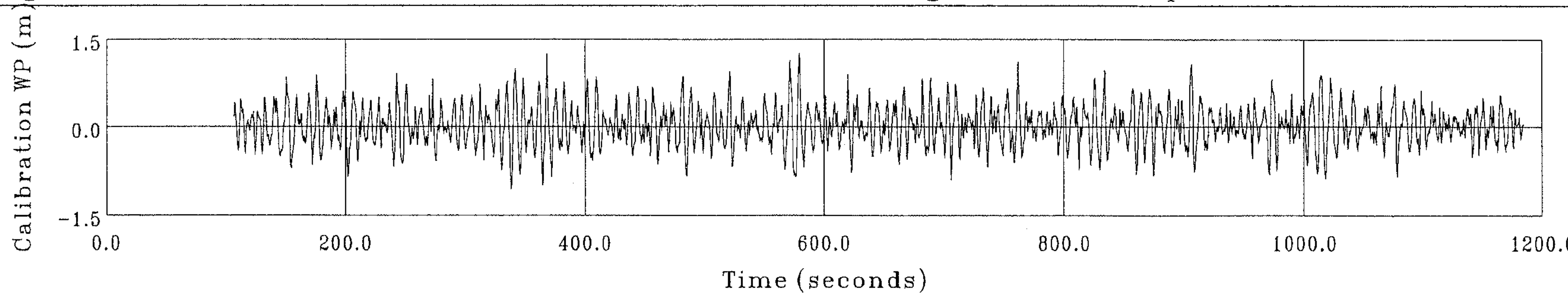
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

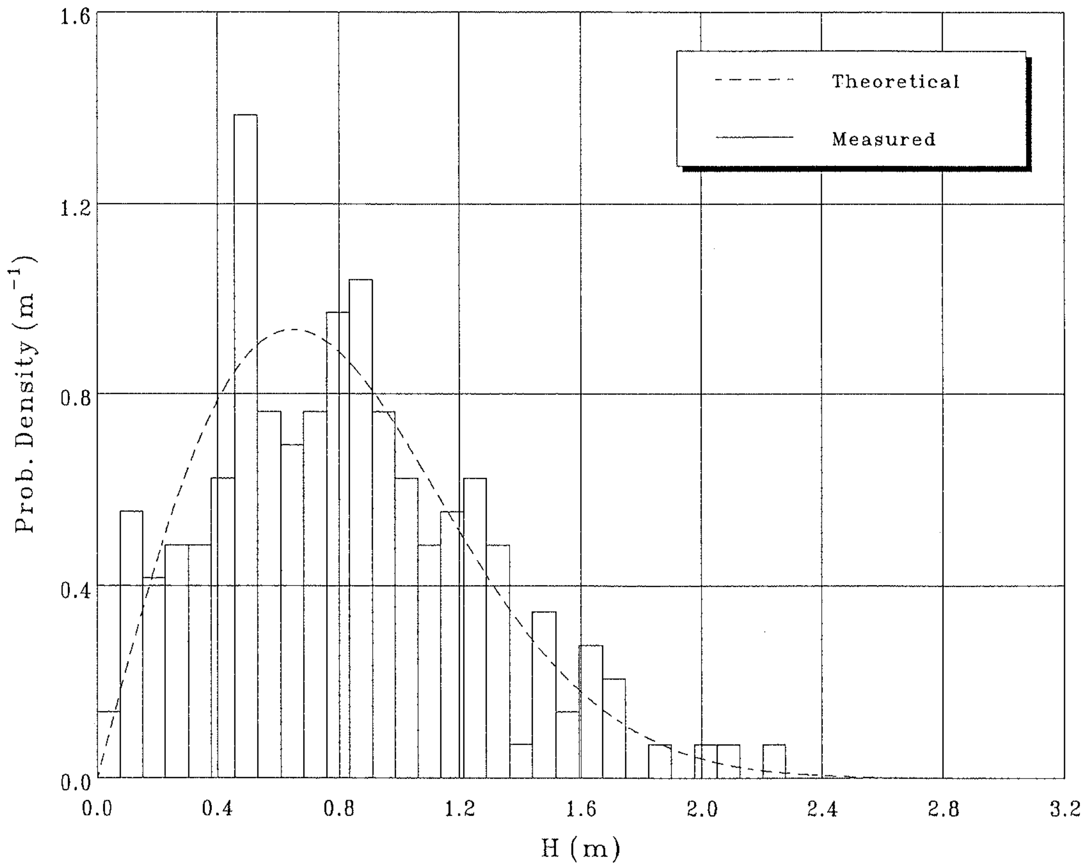
Figure A81 MUN65_WAVE2_005

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 11:05:30
Acquired: 4-NOV-2004 10:56:07





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	2.099 m	2.248 m
T_{Hmax}	6.400 s	6.481 s
$H_{1/3}$	1.351 m	1.314 m
$H_{1/10}$	1.703 m	1.673 m
$H_{1/100}$	2.028 m	2.158 m
AC_{Max}	1.254 m	

		Target
H_s	= 1.3322 m	1.3700 m
Deviation from target H_s	= -2.759 %	(5.0 %)

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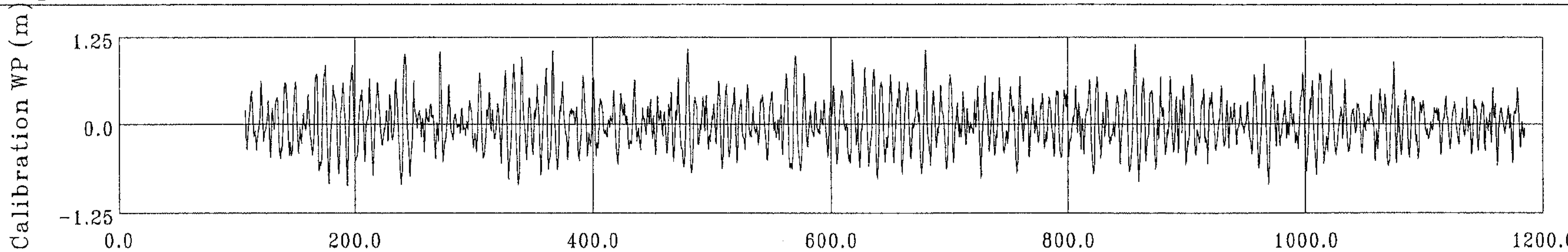
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

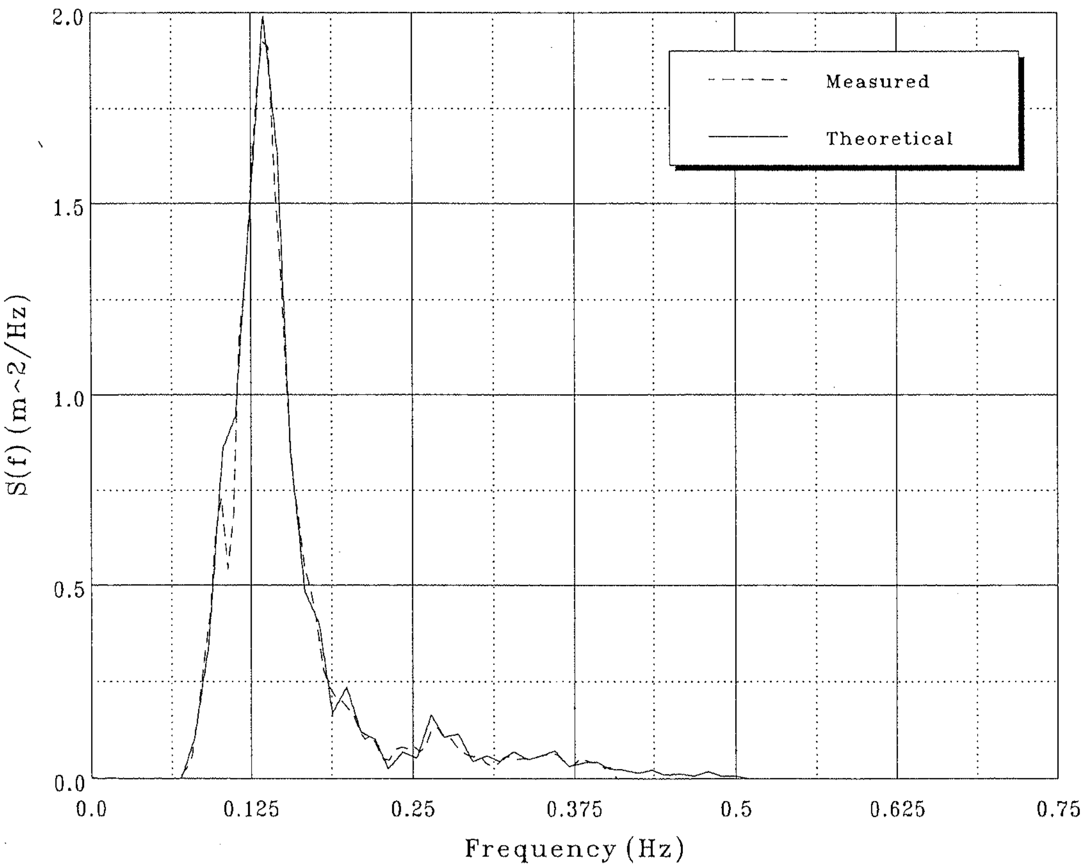
Figure A81 MUN65_WAVE2_005

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 11:46:50
Acquired: 4-NOV-2004 11:35:59





		TARGET / (TOLERANCE)
Spectral Analysis:		
Hm_0	= 1.3393 m	
T_{pd}	= 7.4437 s	7.4200 s
m_0	= 0.1121	
m_2	= 0.0030	
T_Z	= 6.0749 s	
ε_4	= 0.6840	
DOF	= 22.00	
Deviation from target T_p	= 0.3194 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.2984 m	1.3700 m
Deviation from target H_s	= -5.225 %	(5.0 %)

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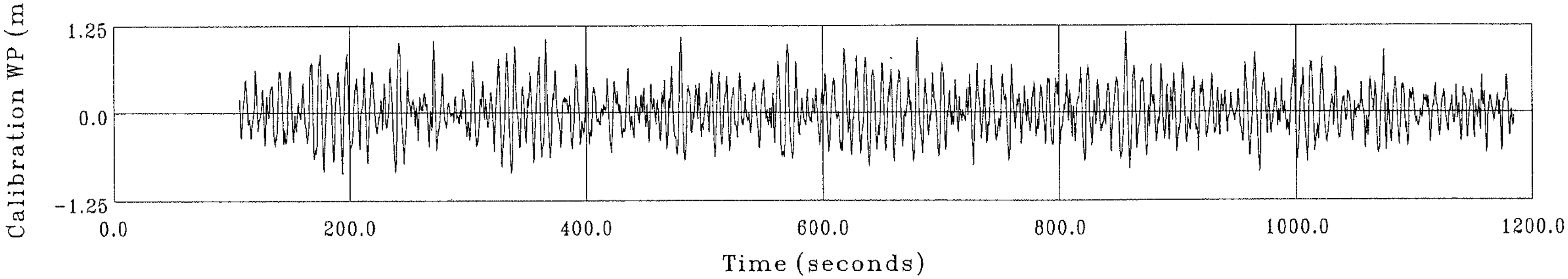
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

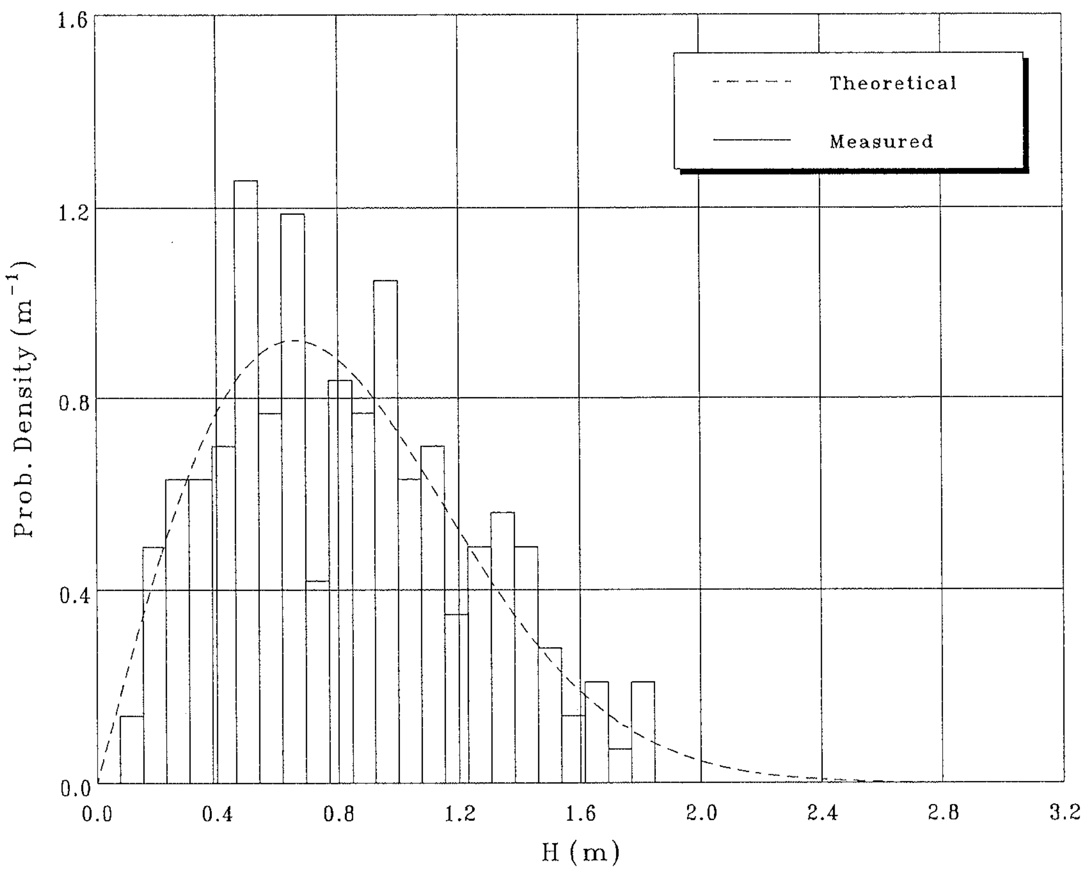
Figure A83 MUN65F_WAVE2_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 04-NOV-2004 11:46:50
Acquired: 4-NOV-2004 11:35:59





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	1.966 m	1.838 m
T_{Hmax}	6.989 s	7.775 s
$H_{1/3}$	1.299 m	1.298 m
$H_{1/10}$	1.584 m	1.576 m
$H_{1/100}$	1.860 m	1.824 m
AC_{Max}	1.160 m	

		Target
H_s	= 1.2984 m	1.3700 m
Deviation from target H_s	= -5.225 %	(5.0 %)

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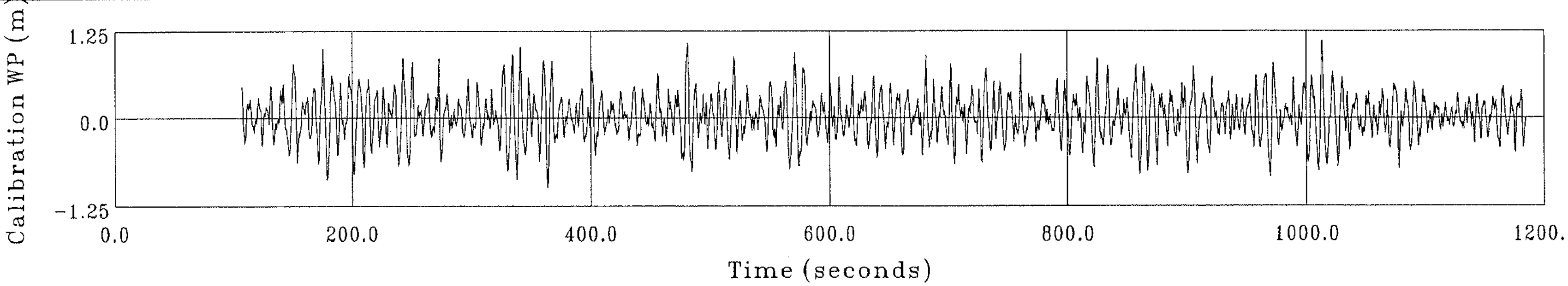
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

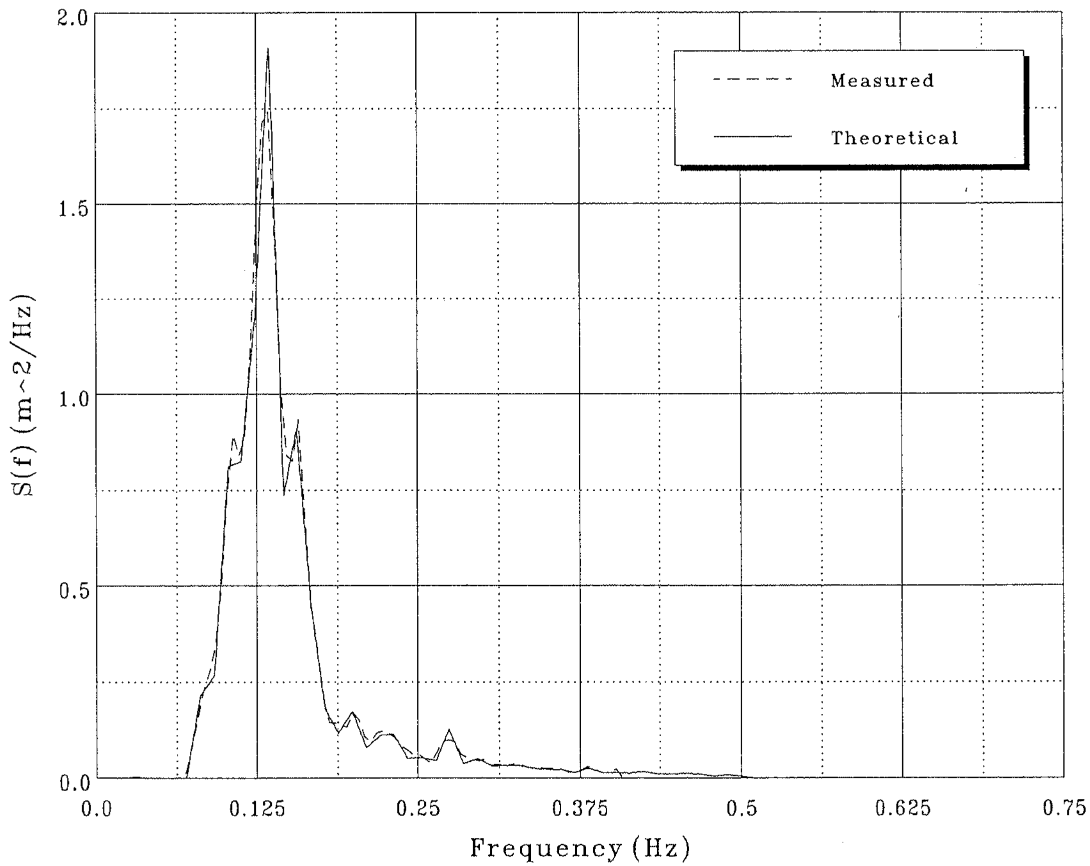
Figure A83 MUN65F_WAVE2_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 16:57:58
Acquired: 5-NOV-2004 16:48:37





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 1.2443 m	
T_{pd}	= 7.5934 s	7.4200 s
m_0	= 0.0968	
m_2	= 0.0024	
T_Z	= 6.3633 s	
ε_4	= 0.6615	
DOF	= 22.00	
Deviation from target T_p	= 2.337 %	(2.5 %)

Zero-Crossing Analysis:		
H_s	= 1.2228 m	1.2500 m
Deviation from target H_s	= -2.177 %	(5.0 %)

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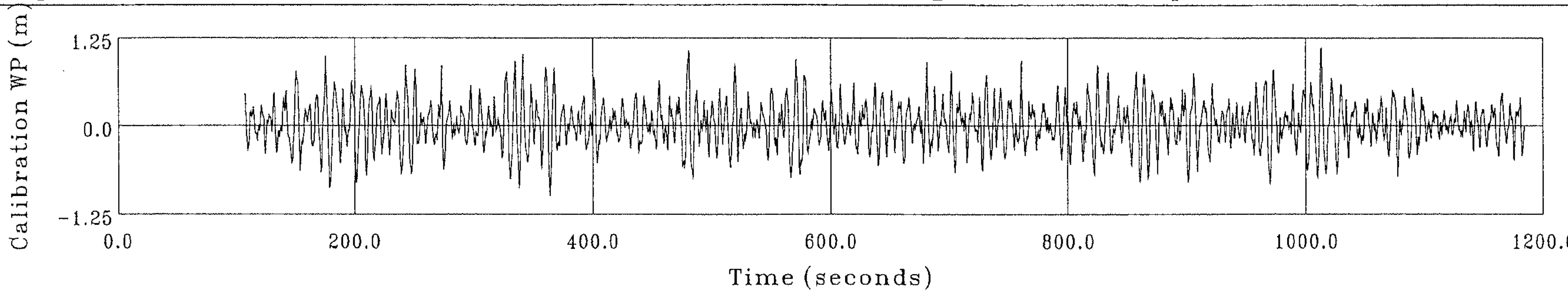
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

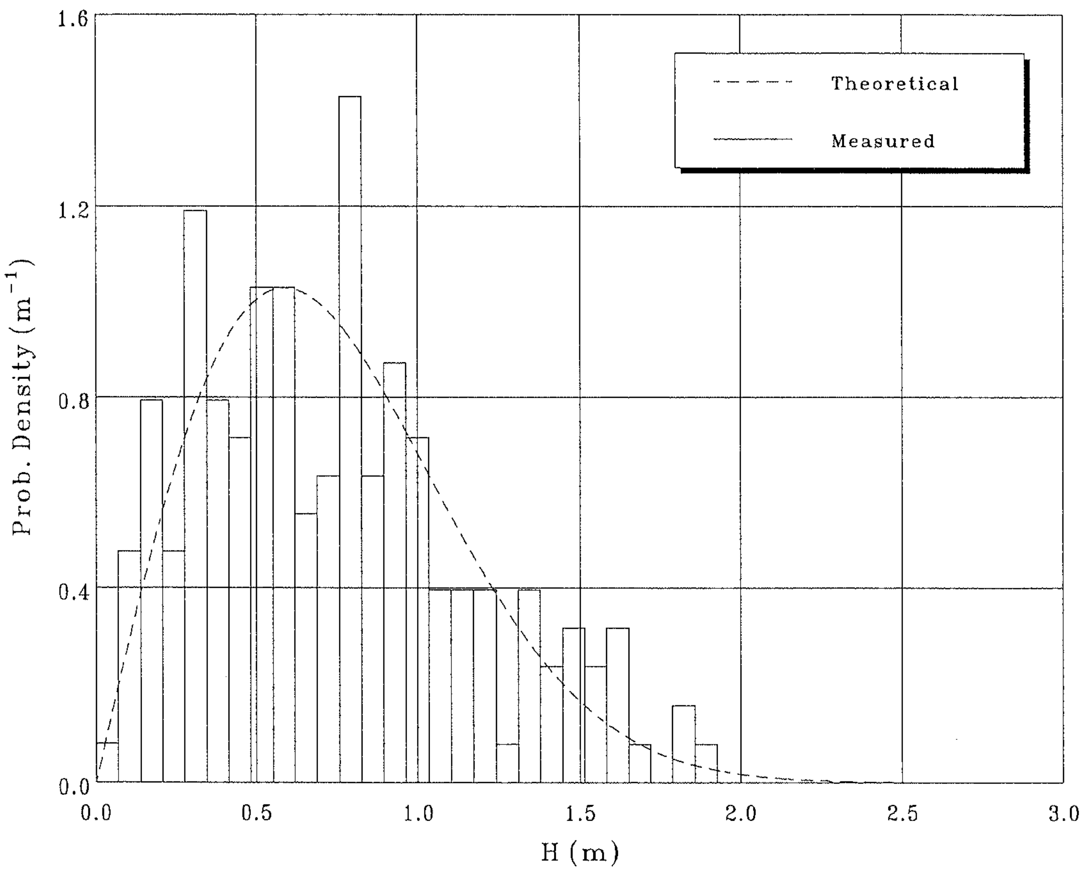
Figure A121 MUN25_WAVE3_006

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 16:57:58
Acquired: 5-NOV-2004 16:48:37





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	1.867 m	1.895 m
T_{Hmax}	8.210 s	6.574 s
$H_{1/3}$	1.225 m	1.221 m
$H_{1/10}$	1.562 m	1.580 m
$H_{1/100}$	1.842 m	1.860 m
AC_{Max}	1.106 m	

		Target
H_s	= 1.2228 m	1.2500 m
Deviation from target H_s	= -2.177 %	(5.0 %)

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Institute for Ocean Technology

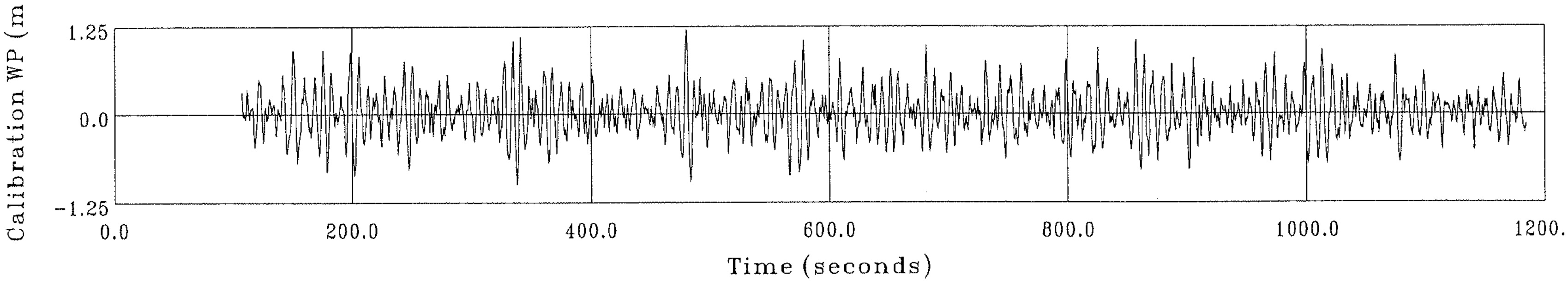
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

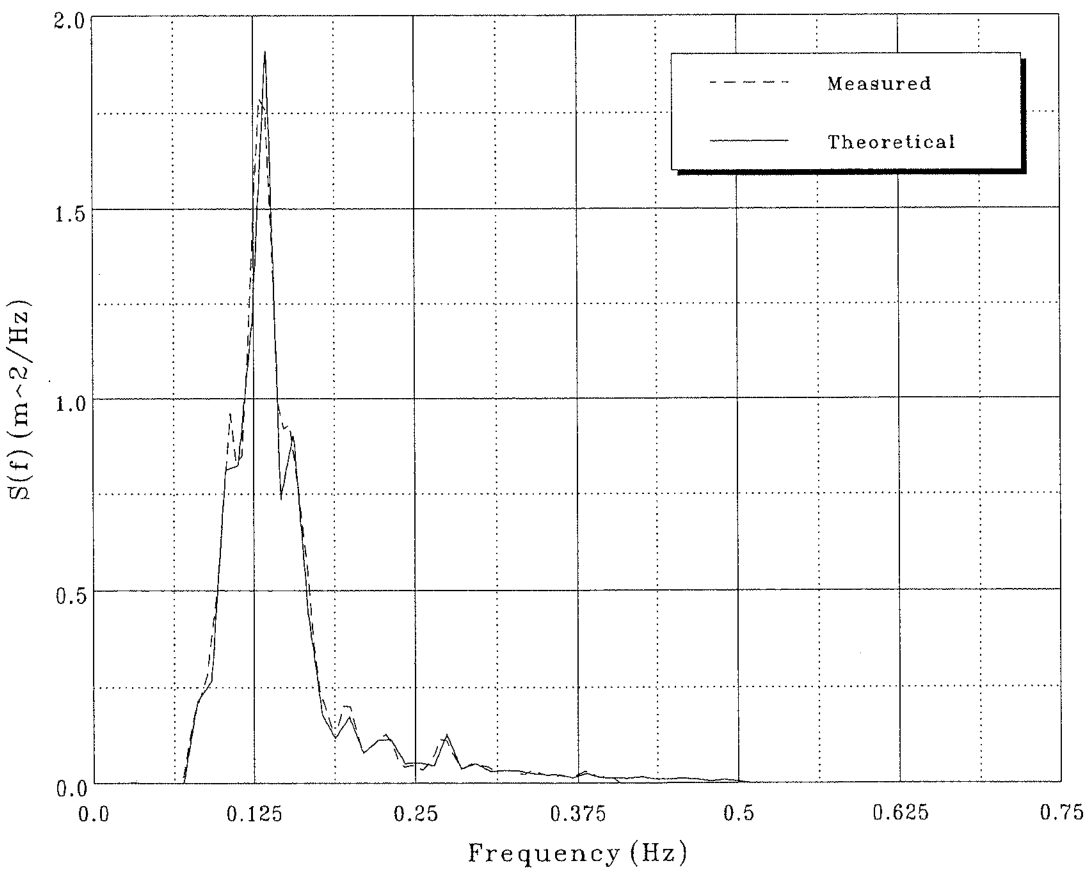
Figure A121 MUN25_WAVE3_006

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 15:46:32
Acquired: 5-NOV-2004 15:37:04





		TARGET / (TOLERANCE)
Spectral Analysis:		
Hm_0	= 1.2583 m	
T_{pd}	= 7.6020 s	7.4200 s
m_0	= 0.0990	
m_2	= 0.0024	
T_Z	= 6.4165 s	
ε_4	= 0.6581	
DOF	= 22.00	
Deviation from target T_p	= 2.452 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.2384 m	1.2500 m
Deviation from target H_s	= -0.9248 %	(5.0 %)

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Institute for Ocean Technology

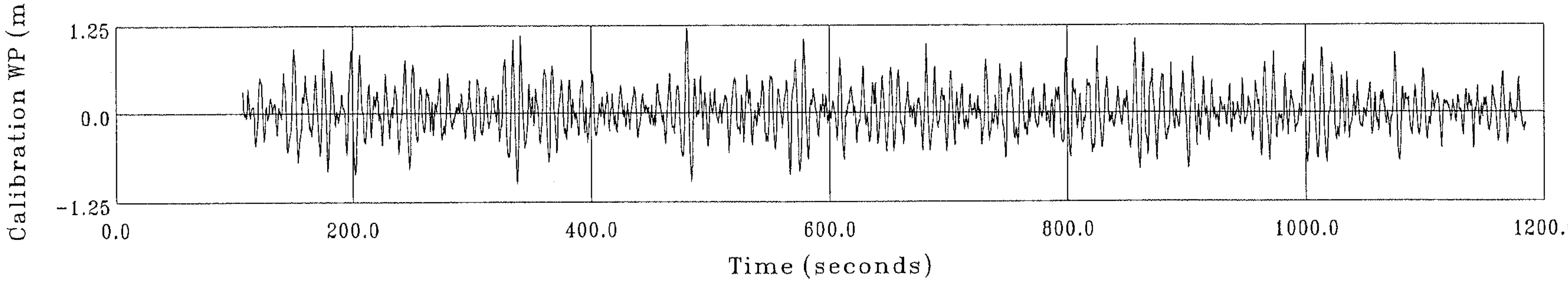
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

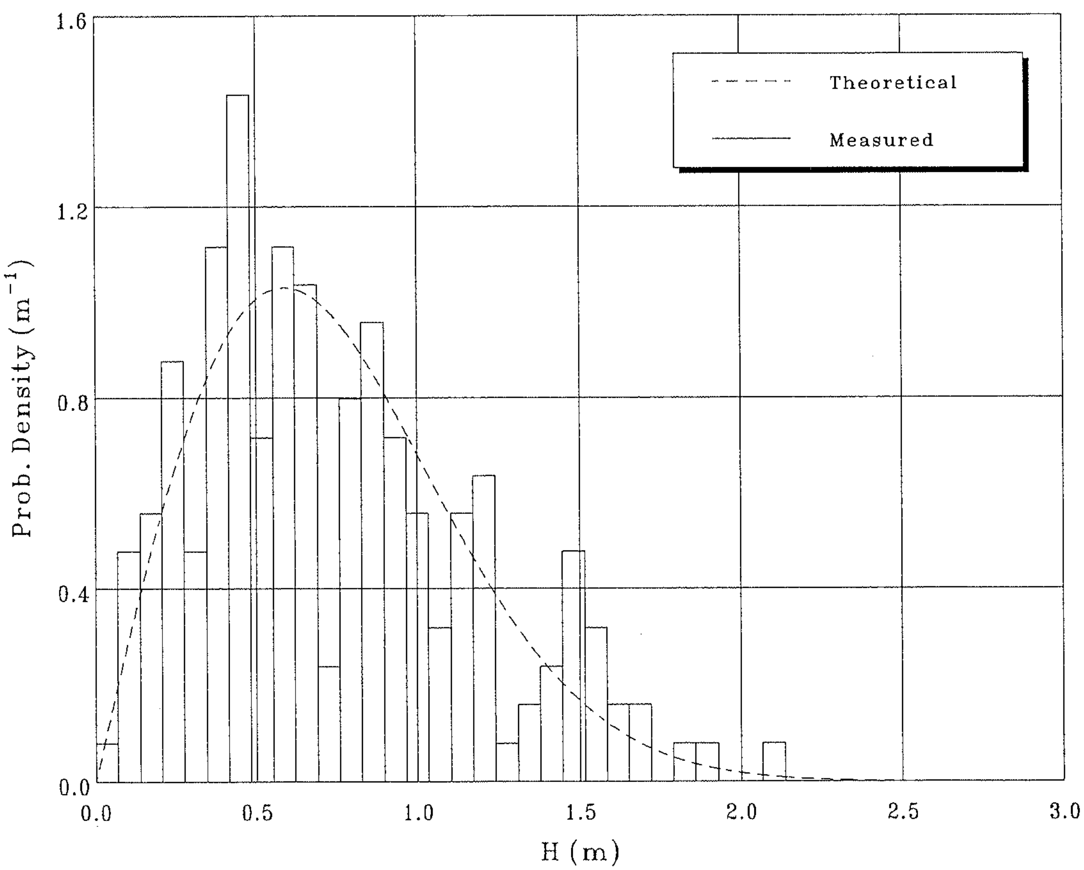
Figure A117 MUN25F_WAVE3_004

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 15:46:32
Acquired: 5-NOV-2004 15:37:04





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	2.150 m	2.099 m
T_{Hmax}	7.464 s	6.765 s
$H_{1/3}$	1.236 m	1.240 m
$H_{1/10}$	1.620 m	1.606 m
$H_{1/100}$	2.095 m	1.983 m
AC_{Max}	1.220 m	

		Target
H_s	= 1.2384 m	1.2500 m
Deviation from target H_s	= -0.9248 %	(5.0 %)

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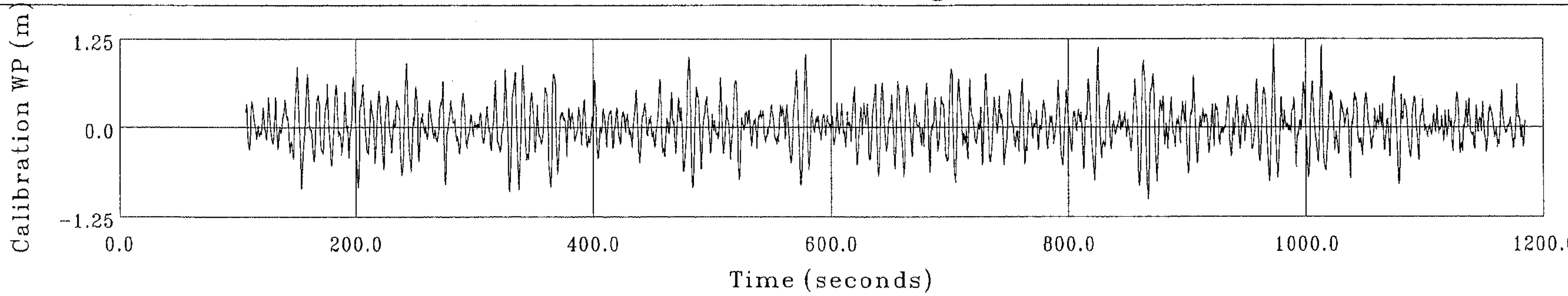
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

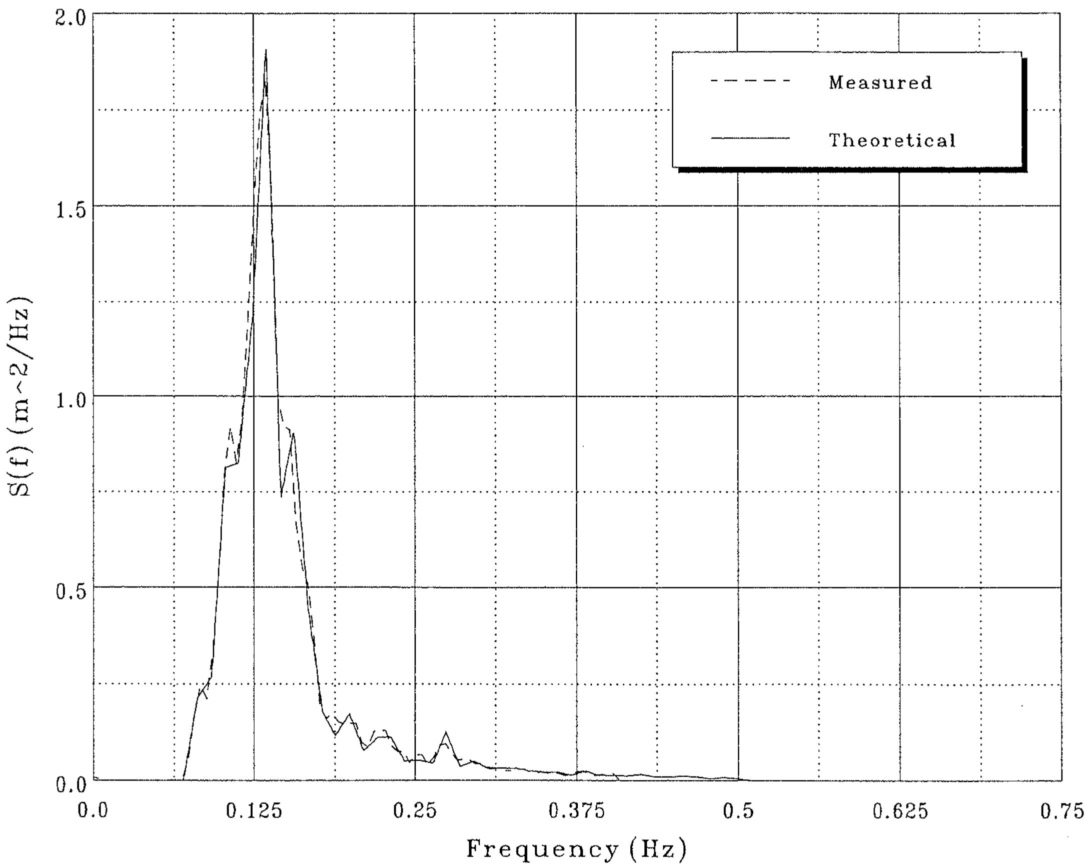
Figure A117 MUN25F_WAVE3_004

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 16:04:48
Acquired: 5-NOV-2004 15:54:57





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 1.2500 m	
T_{pd}	= 7.5663 s	7.4200 s
m_0	= 0.0977	
m_2	= 0.0024	
T_Z	= 6.4320 s	
ε_4	= 0.6555	
DOF	= 22.00	
Deviation from target T_p	= 1.972 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.2435 m	1.2500 m
Deviation from target H_s	= -0.5163 %	(5.0 %)

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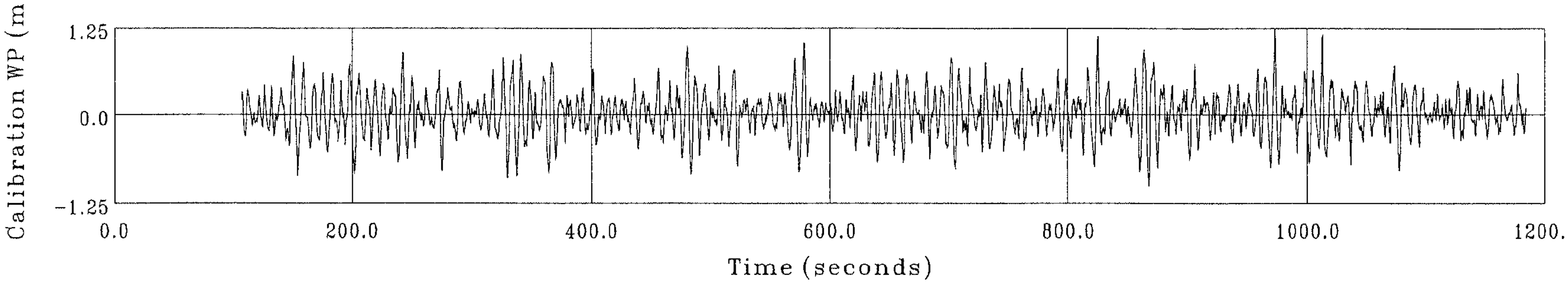
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

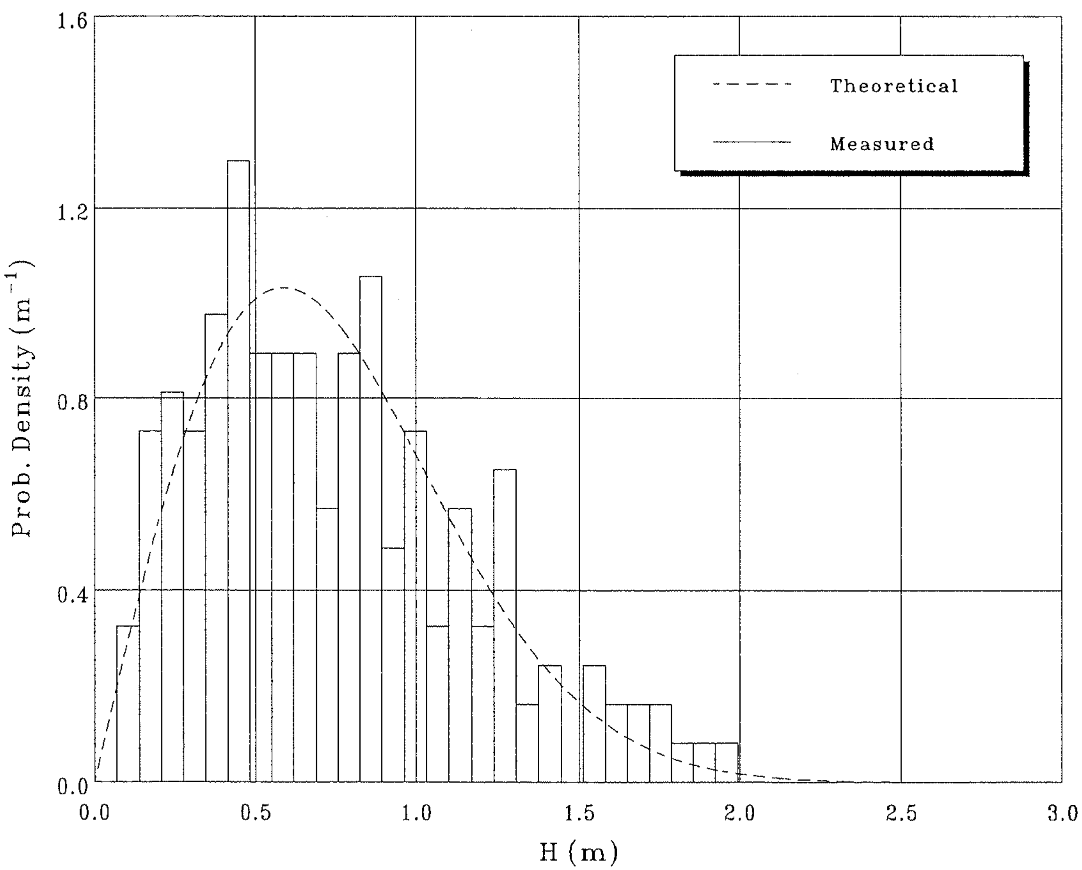
Figure A118 MUN65_WAVE3_006

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 16:04:48
Acquired: 5-NOV-2004 15:54:57





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	1.941 m	1.987 m
T_{Hmax}	7.224 s	7.547 s
$H_{1/3}$	1.264 m	1.223 m
$H_{1/10}$	1.620 m	1.593 m
$H_{1/100}$	1.910 m	1.931 m
AC_{Max}	1.241 m	

		Target
H_s	= 1.2435 m	1.2500 m
Deviation from target H_s	= -0.5163 %	(5.0 %)

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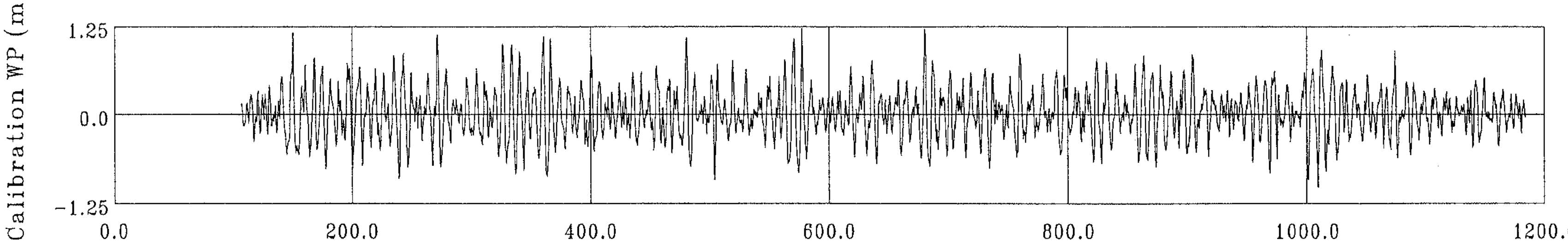
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

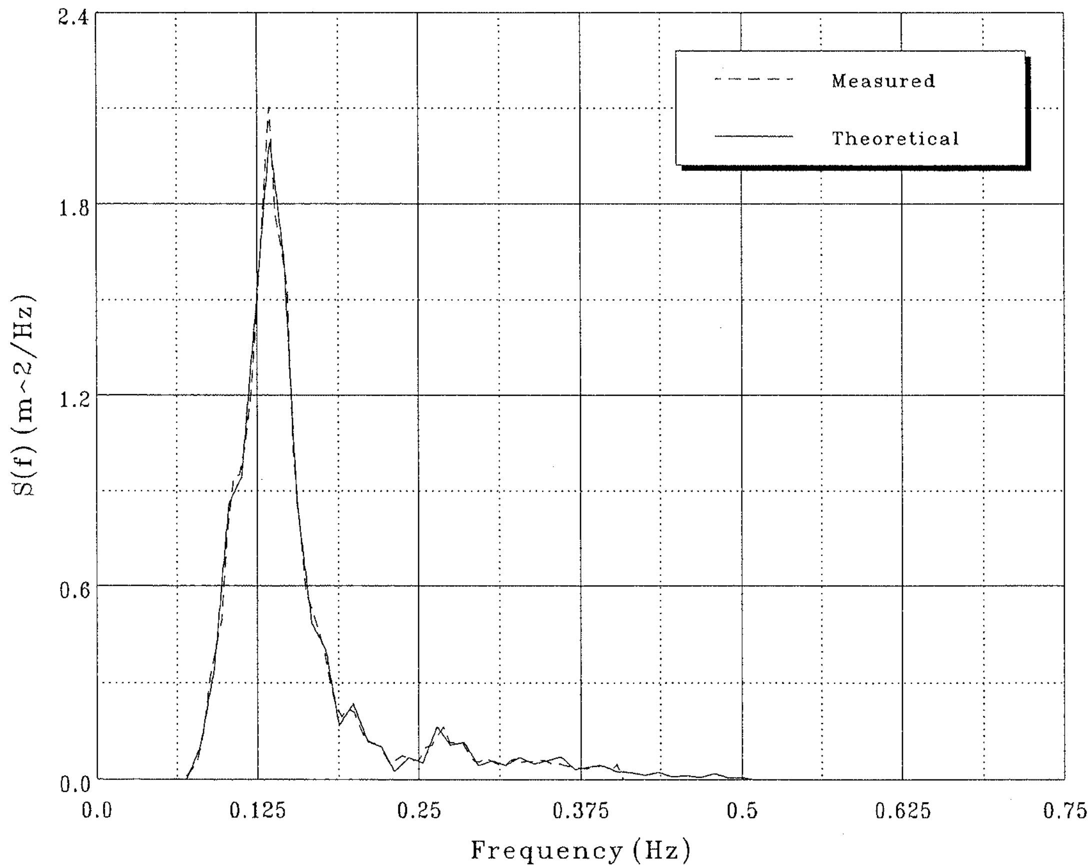
Figure A118 MUN65_WAVE3_006

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 12:39:51
Acquired: 5-NOV-2004 12:30:22





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 1.3598 m	
T_{pd}	= 7.3913 s	7.4200 s
m_0	= 0.1156	
m_2	= 0.0031	
T_Z	= 6.0723 s	
ε_4	= 0.6826	
DOF	= 22.00	
Deviation from target T_p	= 0.3869 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.3501 m	1.3700 m
Deviation from target H_s	= -1.455 %	(5.0 %)

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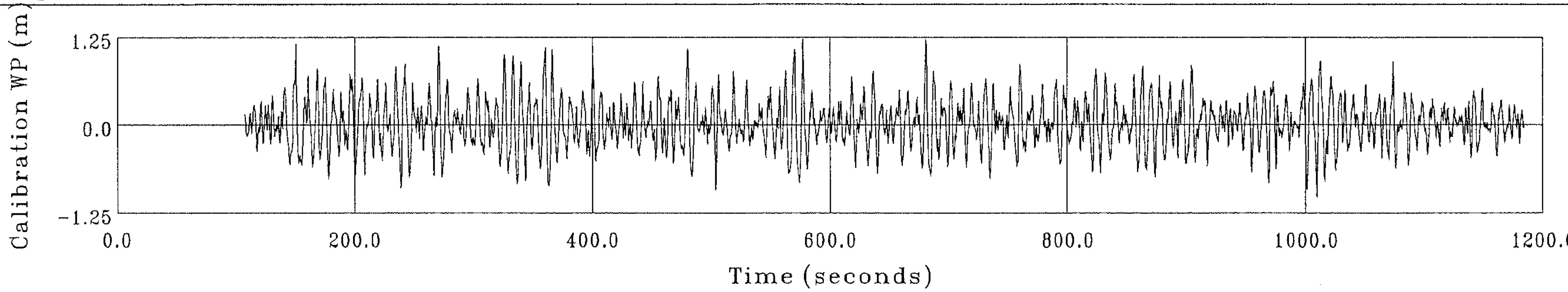
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

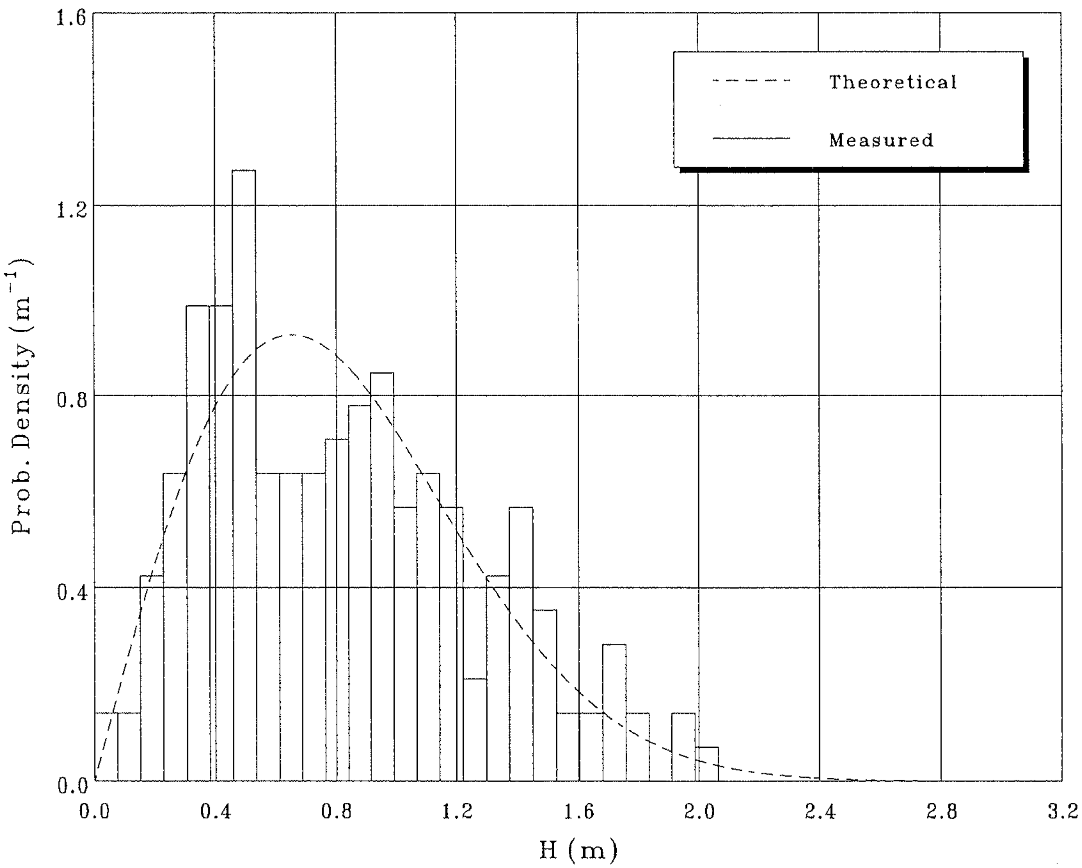
Figure A108 IOT25_WAVE2_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 12:39:51
Acquired: 5-NOV-2004 12:30:22





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	1.954 m	2.029 m
T_{Hmax}	7.218 s	6.999 s
$H_{1/3}$	1.362 m	1.338 m
$H_{1/10}$	1.715 m	1.665 m
$H_{1/100}$	1.933 m	1.980 m
AC_{Max}	1.226 m	

		Target
H_s	= 1.3501 m	1.3700 m
Deviation from target H_s	= -1.455 %	(5.0 %)

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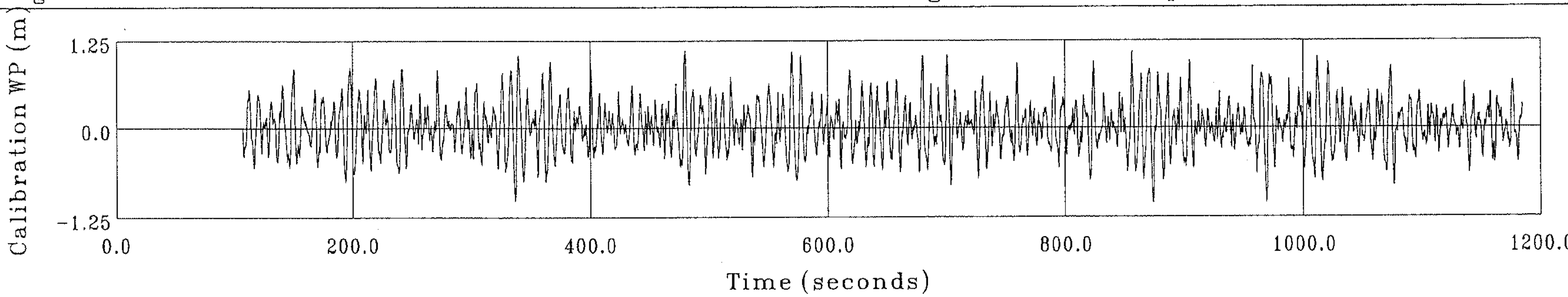
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

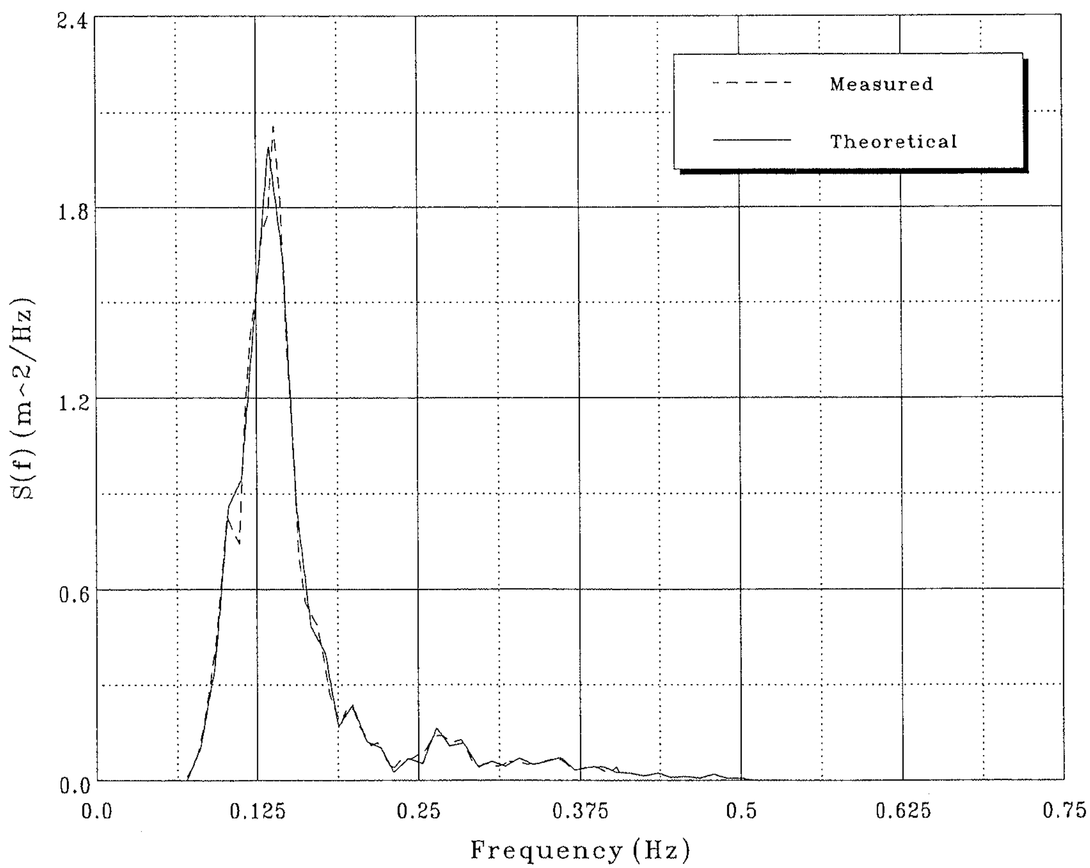
Figure A108 IOT25_WAVE2_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 13:18:00
Acquired: 5-NOV-2004 13:08:39





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 1.3612 m	
T_{pd}	= 7.3066 s	7.4200 s
m_0	= 0.1158	
m_2	= 0.0031	
T_Z	= 6.0842 s	
ε_4	= 0.6834	
DOF	= 22.00	
Deviation from target T_p	= 1.528 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.3158 m	1.3700 m
Deviation from target H_s	= -3.953 %	(5.0 %)

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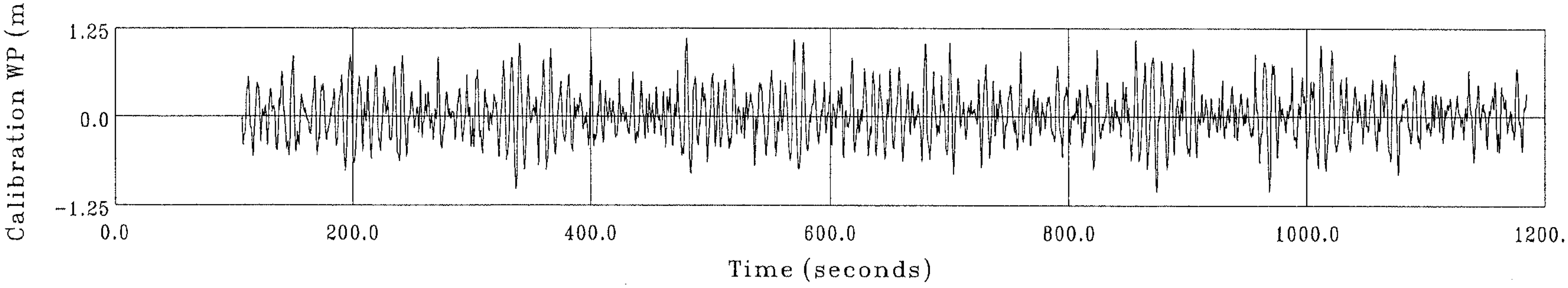
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

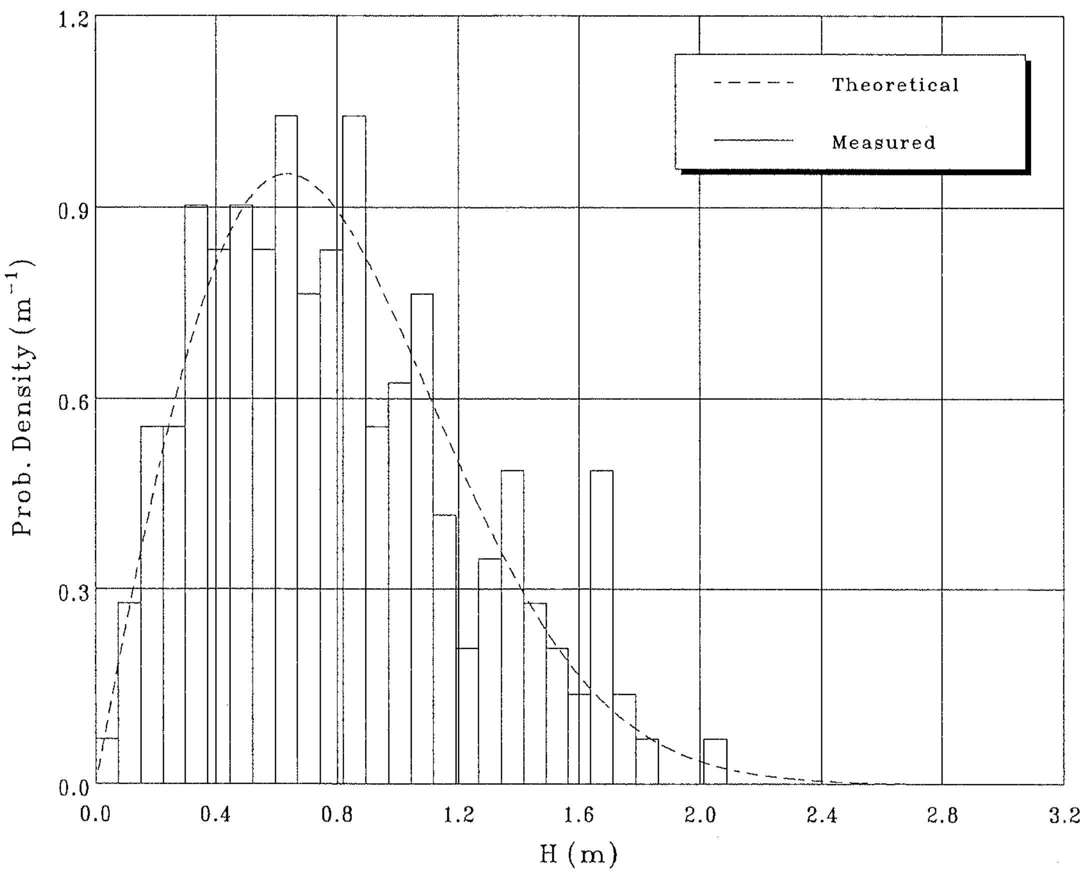
Figure A110 IOT65_WAVE2_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 13:18:00
Acquired: 5-NOV-2004 13:08:39





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	1.899 m	2.049 m
T_{Hmax}	6.593 s	7.270 s
$H_{1/3}$	1.330 m	1.302 m
$H_{1/10}$	1.667 m	1.651 m
$H_{1/100}$	1.897 m	1.947 m
AC_{Max}	1.105 m	

		Target
H_s	= 1.3158 m	1.3700 m
Deviation from target H_s	= -3.953 %	(5.0 %)

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Institute for Ocean Technology

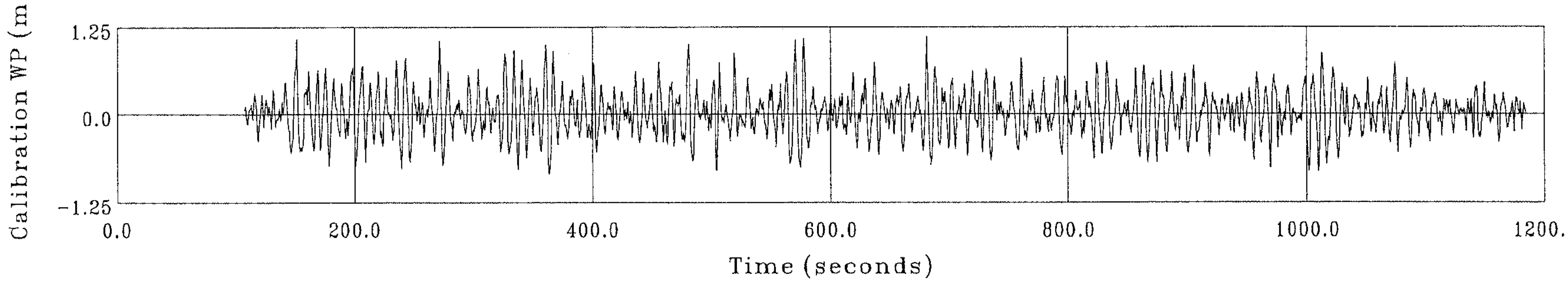
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

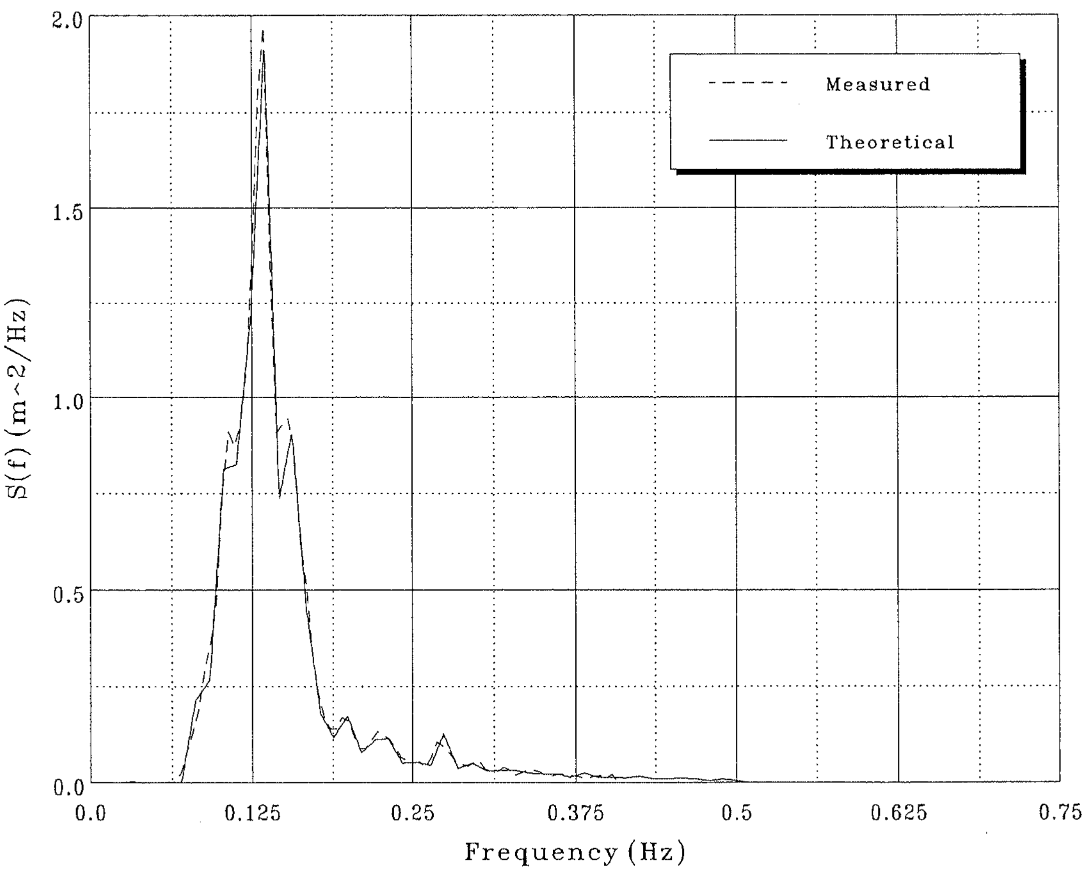
Figure A110 IOT65_WAVE2_002

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 16:22:35
Acquired: 5-NOV-2004 16:13:14





		TARGET / (TOLERANCE)
Spectral Analysis:		
Hm_0	= 1.2482 m	
T_{pd}	= 7.5468 s	7.4200 s
m_0	= 0.0974	
m_2	= 0.0024	
T_Z	= 6.4087 s	
ε_4	= 0.6530	
DOF	= 22.00	
Deviation from target T_p	= 1.708 %	(2.5 %)
Zero-Crossing Analysis:		
H_s	= 1.2458 m	1.2500 m
Deviation from target H_s	= -0.3384 %	(5.0 %)

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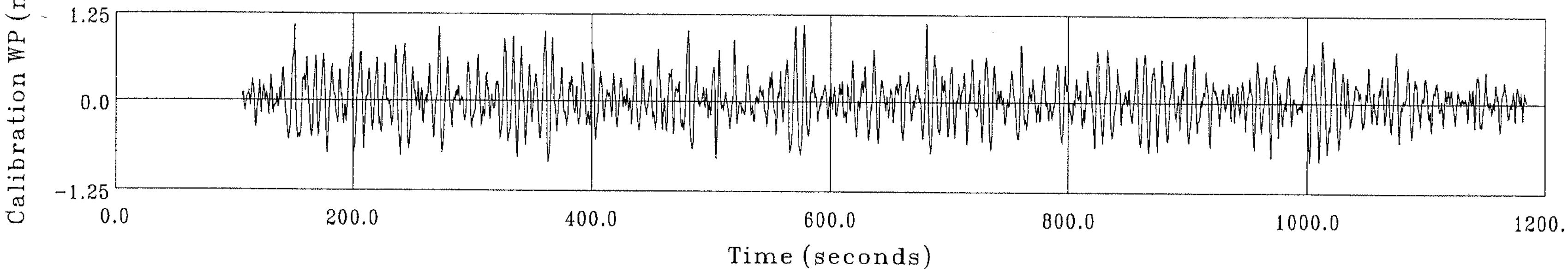
GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

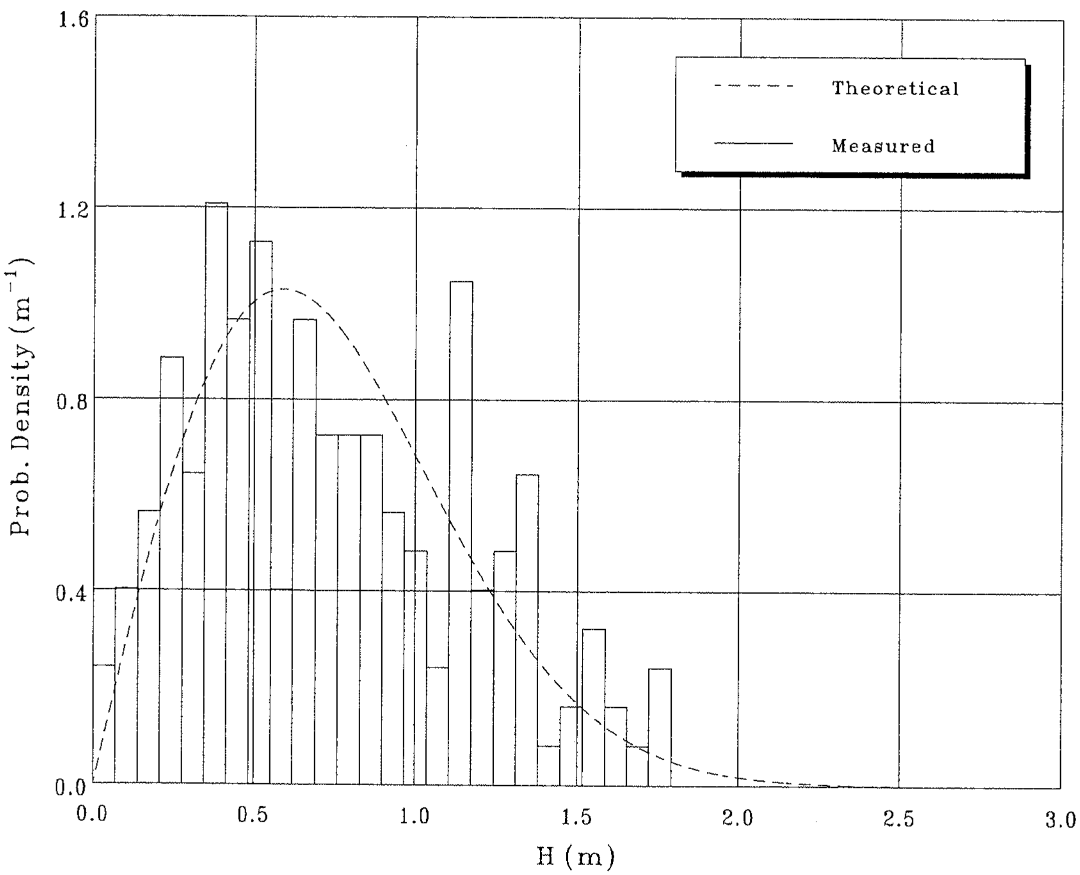
Figure A119 IOT25_WAVE3_003

Fishing Vessels
Irregular Wave

D Cumming

Analyzed: 05-NOV-2004 16:22:35
Acquired: 5-NOV-2004 16:13:14





Zero-Crossing Analysis:

	Up-Crossing	Down-Crossing
H_{max}	1.832 m	1.778 m
T_{Hmax}	7.154 s	7.071 s
$H_{1/3}$	1.244 m	1.248 m
$H_{1/10}$	1.547 m	1.531 m
$H_{1/100}$	1.816 m	1.766 m
AC_{Max}	1.114 m	

		Target
H_s	= 1.2458 m	1.2500 m
Deviation from target H_s	= -0.3384 %	(5.0 %)

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Institute for Ocean Technology

GENERATED BY: IOT | CHECKED BY: | APPROVED BY:

Figure A119 IOT25_WAVE3_003

APPENDIX E: RUN LOG / VIDEO LOG

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 — **Proj. 2017** — **Jan. 10 - Feb. 14, 2005**

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	Online Data Analysis End Time	Comments
10-Jan-05			Ch_check_001					
11-Jan-05	10:03:30		Ch_check_002					Channel check
11-Jan-05	10:20:54		Sign_check_001	0	0:00:00			Roll (+), Pitch (-), Yaw (+ then -) Annotation not correct time out by +30min
11-Jan-05	11:01:30		Sign_check_002	0	0:00:46			X (+), Y (-), Z (+) Annotation correct, missed part of X move to west
11-Jan-05	13:35:45		calm_check_001					
11-Jan-05	13:53:32		calm_check_002					Lost Track at X -27m
11-Jan-05	14:06:19		calm_check_003					Grabbed new QUALISYS body fall at tank center try again
12-Jan-05	9:36:57		Sign_check_003	0	0:02:30			Roll (+), Pitch (-), Yaw (+)
12-Jan-05	9:46:04		Sign_check_004	0	0:04:01			Roll Rate(+), Pitch Rate(-), Yaw Rate(+)
12-Jan-05	10:01:20		Sign_check_005	0	0:05:57			MP Surge (+), MP Sway (+), MP Heave (+), Bow Vert (+), Bow Lat (+)
12-Jan-05	10:10:21		Sign_check_006	0	0:09:58			MP Surge (+), MP Sway (+), MP Heave (+), Bow Vert (+), Bow Lat (+)
12-Jan-05	10:53:30		Track_check_001					model driven around tank
12-Jan-05	11:27:20		Speed_cal_001					Shaft Speed 500 RPM
12-Jan-05	11:36:18		Speed_cal_002					Shaft Speed 1000 RPM
12-Jan-05	11:42:26		Speed_cal_003					Shaft Speed 1500 RPM
12-Jan-05	14:06:17		Speed_cal_004					1500 RPM. Actual 1280 RPM (8 Knots) Accepted
12-Jan-05	14:17:00		Speed_cal_005					620 RPM (4 Kknots) Accepted
12-Jan-05	15:27:17	Mun25F_wave1_MDS	Check_run_001	1	0:00:00			4 knots. Wave heading 205. Ramp speed to 635 RPM in waves. Model position east center
12-Jan-05	15:38:40	Mun25F_wave1_MDS	Check_run_002	1	0:01:49			4 knots. Wave heading 205. Ramp speed to 655 RPM in waves. Model position east center
								Run Sequence #1, 4 knots, wave hdg 205 deg. - MUN wave
13-Jan-05	8:15:00							Start Wavemaker Hydraulics and change batteries in model
13-Jan-05								Clean and rezero waveprobes
13-Jan-05	9:19:41	Mun25F_wave1_MDS	Check_run_003	1	0:03:33	N/A	N/A	4 knots. Wave heading 205. Ramp speed to 670 RPM in waves. Model position east center
13-Jan-05	9:35:56	Mun25F_wave1_MDS	Check_run_004	1	0:05:38	N/A	N/A	Repeat previous run. Rudder not enabled. Launch 45 seconds into acquistion.Set RPM to 690
13-Jan-05	9:50:01	Mun25F_wave1_MDS	Run_001	1	0:07:24	N/A	N/A	Speed accepted @ 690 RPM (4 Knots) Starting series at 8:25 sec
13-Jan-05	10:05:01	Mun25F_wave1_MDS	Run_002	1	0:08:49	N/A	N/A	Speed accepted @ 690 RPM (4 Knots) Launch model at 7:45 sec
13-Jan-05	11:10:34	Mun25F_wave1_MDS	Run_003	1	0:10:39	N/A	N/A	Set RPM back to 640. Tag line was hook up wrong for run 1 and 2. Line was wrap around pully at water level. Start waves again
13-Jan-05	11:22:01	Mun25F_wave1_MDS	Run_004	1	0:13:10	N/A	N/A	
13-Jan-05	11:35:33	Mun25F_wave1_MDS	Run_005	1	0:14:48	286.06	321.28	Accepted 670 RPM for 4 Knots speed. Launch at 7:37 and set span to 1 at 8:22
13-Jan-05	11:48:52	Mun25F_wave1_MDS	Run_006	1	0:16:25	306.32	390.01	Accepted 670 RPM for 4 Knots speed. Launch at 6:55 and set span to 1 at 7:40
13-Jan-05	12:04:50	Mun25F_wave1_MDS	Run_007	1	0:18:12	387.38	485.55	Accepted 670 RPM for 4 Knots speed. Launch at 6:20 and set span to 1 at 7:05
13-Jan-05								Change batteries in model. Adjust RPM to 690.
13-Jan-05	13:20:34	Mun25F_wave1_MDS	Run_008	1	0:20:02	476.80	572.51	Accepted 690 RPM for 4 Knots speed. Launch at 5:36 and set span to 1 at 6:21
13-Jan-05	13:40:20	Mun25F_wave1_MDS	Run_009	1	0:21:31	N/A	N/A	~~Accepted~~ 690 RPM for 4 Knots speed. Launch at 4:56 and set span to 1 at 5:41
13-Jan-05	13:52:20	Mun25F_wave1_MDS	Run_010	1	0:23:26	563.20	670.72	Accepted 690 RPM for 4 Knots speed. Launch at 4:56 and set span to 1 at 5:41 Repeat of previous run. Delay on launch.
13-Jan-05	14:06:22	Mun25F_wave1_MDS	Run_011	1	0:24:54	663.78	759.75	Accepted 690 RPM for 4 Knots speed. Launch at 4:11 and set span to 1 at 4:56
13-Jan-05	14:21:05	Mun25F_wave1_MDS	Run_012	1	0:26:34	743.84	846.80	Accepted 690 RPM for 4 Knots speed. Launch at 3:30 and set span to 1 at 4:15
13-Jan-05	14:35:50	Mun25F_wave1_MDS	Run_013	1	0:28:03	839.94	940.61	Accepted 690 RPM for 4 Knots speed. Launch at 2:49 and set span to 1 at 3:35
13-Jan-05	14:46:50	Mun25F_wave1_MDS	Run_014	1	0:29:40	925.35	1015.1	Accepted 690 RPM for 4 Knots speed. Launch at 2:06 and set span to 1 at 2:51
13-Jan-05	14:58:51	Mun25F_wave1_MDS	Run_015	1	0:31:16	1004.2	1097.8	Accepted 690 RPM for 4 Knots speed. Launch at 1:31 and set span to 1 at 2:16
13-Jan-05	15:13:06	Mun25F_wave1_MDS	Run_016	1	0:32:53	N/A	N/A	Accepted 690 RPM for 4 Knots speed. Launch at 0:53 and set span to 1 at 1:38
								Repeat run # 016. Added time 60 seconds onto Acq. Wrong start time given to operator. Run_016 - no online analysis
13-Jan-05	15:26:16	Mun25F_wave1_MDS	Run_017	1	0:34:34	1083.8	1182.9	Accepted 690 RPM for 4 Knots speed. Launch at 1:53 and set span to 1 at 2:38. Ant. Run not changed.
								Run Sequence #2, 4 knots, wave hdg 245 deg. - MUN wave
14-Jan-05	8:15:00							Start Wavemaker Hydraulics and change batteries in model
14-Jan-05								Clean and rezero waveprobes
14-Jan-05	9:06:05	mun65F_wave2_MDS	Run_018	1	0:36:11	N/A	N/A	~~Accepted~~ 690 RPM for 4 Knots speed. Launch at 9:25 and set span to 1 at 10:10. High yaw angle noted
14-Jan-05	9:16:46	mun65F_wave2_MDS	Run_019	1	0:37:51	193.62	292.87	Accepted 690 RPM for 4 Knots speed. Launch at 8:47 and set span to 1 at 9:32
14-Jan-05	9:28:16	mun65F_wave2_MDS	Run_020	1	0:38:38	279.46	378.32	Accepted 690 RPM for 4 Knots speed. Launch at 8:06 and set span to 1 at 8:51
14-Jan-05	9:40:36	mun65F_wave2_MDS	Run_021	1	0:39:59	107.09	207.29	**Repeat run of #18** due to high yaw angle. Accepted 690 RPM for 4 Knots speed. Launch at 9:25 and set span to 1 at 10:10.
14-Jan-05	9:50:37	mun65F_wave2_MDS	Run_022	1	0:41:43	364.10	466.58	Accepted 690 RPM for 4 Knots speed. Launch at 7:26 and set span to 1 at 8:11
14-Jan-05	10:00:28	mun65F_wave2_MDS	Run_023	1	0:43:05	452.78	552.81	Accepted 690 RPM for 4 Knots speed. Launch at 6:46 and set span to 1 at 7:31
14-Jan-05	10:10:14	mun65F_wave2_MDS	Run_024	1	0:44:27	543.06	642.44	Accepted 690 RPM for 4 Knots speed. Launch at 6:06 and set span to 1 at 6:51
14-Jan-05	10:22:49	mun65F_wave2_MDS	Run_025	1	0:46:04	627.95	729.14	Accepted 690 RPM for 4 Knots speed. Launch at 5:24 and set span to 1 at 6:09

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 | **Proj. 2017** | **Jan. 10 - Feb. 14, 2005**

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	End Time	Comments
14-Jan-05	10:32:52	mun65F_wave2_MDS	Run_026	1	0:47:25	718.79	817.27	Accepted 690 RPM for 4 Knots speed. Launch at 4:44 and set span to 1 at 5:29
14-Jan-05	10:49:25	mun65F_wave2_MDS	Run_027	1	0:49:01	805.37	900.39	Accepted 690 RPM for 4 Knots speed. Launch at 4:03 and set span to 1 at 4:48
14-Jan-05	11:02:37	mun65F_wave2_MDS	Run_028	1	0:50:24	885.04	981.36	Accepted 690 RPM for 4 Knots speed. Launch at 3:24 and set span to 1 at 4:09
14-Jan-05	11:16:33	mun65F_wave2_MDS	Run_029	1	0:51:55	964.67	1060.3	Accepted 690 RPM for 4 Knots speed. Launch at 2:47 and set span to 1 at 3:32
14-Jan-05	11:30:57	mun65F_wave2_MDS	Run_030	1	0:53:27	1046.2	1146.6	Accepted 690 RPM for 4 Knots speed. Launch at 2:10 and set span to 1 at 2:55
14-Jan-05	11:44:28	mun65F_wave2_MDS	Run_031	1	0:55:03	1127.7	1230.1	Accepted 690 RPM for 4 Knots speed. Launch at 1:30 and set span to 1 at 2:15
								change angle of model launcher
								Run Sequence #3, 4 knots, wave hdg 210 deg. - MUN wave
14-Jan-05	14:52:35	Mun25_wave1_MDS	Run_032	1	0:56:52	130.38	218.37	Accepted 690 RPM for 4 Knots speed. Launch at 9:25 and set span to 1 at 10:10. High yaw angle noted
14-Jan-05	15:03:24	Mun25_wave1_MDS	Run_033	1	0:58:51	214.15	308.22	Accepted 690 RPM for 4 Knots speed. Launch at 8:41 and set span to 1 at 9:26
14-Jan-05	15:14:19	Mun25_wave1_MDS	Run_034	1	1:00:21	N/A	N/A	Increase RPM to 705 for 4 Knots speed. Launch at 7:59 and set span to 1 at 8:44. No video taken
14-Jan-05	15:25:35	Mun25_wave1_MDS	Run_035	1	1:00:21	298.74	400.31	**Repeat Run of # 034**. RPM set to 705 for 4 Knots speed. Launch at 7:59 and set span to 1 at 8:44. Video Annotation Incorrect
17-Jan-05	8:30:00							Start Wavemaker Hydraulics and change batteries in model
17-Jan-05								Clean and rezero waveprobes
17-Jan-05								Delay starting. Problem communicating with model. One hour delay
17-Jan-05	9:56:31	Mun25_wave1_MDS	Run_036	1	1:02:22	N/A	N/A	~~Accepted~~ 705 RPM for 4 Knots speed. Launch at 7:16 and set span to 1 at 8:01. Poor QUALISYS data.
17-Jan-05	10:14:47	Mun25_wave1_MDS	Run_037	1	1:04:06	399.62	489.26	Accepted 705 RPM for 4 Knots speed. Launch at 7:16 and set span to 1 at 8:01. **Repeat of run # 036.** Model course off to port
17-Jan-05	10:24:31	Mun25_wave1_MDS	Run_038	1	1:05:31	482.44	568.24	Accepted 705 RPM for 4 Knots speed. Launch at 6:37 and set span to 1 at 7:22.
17-Jan-05	10:35:21	Mun25_wave1_MDS	Run_039	1	1:07:09	562.12	654.94	Accepted 705 RPM for 4 Knots speed. Launch at 5:58 and set span to 1 at 6:43
17-Jan-05	10:47:12	Mun25_wave1_MDS	Run_040	1	1:08:40	651.62	746.26	Accepted 705 RPM for 4 Knots speed. Launch at 5:18 and set span to 1 at 6:03. Poor QUALISYS data
17-Jan-05	11:03:23	Mun25_wave1_MDS	Run_041	1	1:10:14	742.46	831.36	Accepted 705 RPM for 4 Knots speed. Launch at 4:36 and set span to 1 at 5:21
17-Jan-05	11:17:36	Mun25_wave1_MDS	Run_042	1	1:11:44	N/A	N/A	~~Accepted~~ 705 RPM for 4 Knots speed. Launch at 3:56 and set span to 1 at 4:41. Model course off to port
17-Jan-05	11:31:02	Mun25_wave1_MDS	Run_043	1	1:13:19	828.56	922.59	Accepted 705 RPM for 4 Knots speed. Launch at 3:56 and set span to 1 at 4:41. **Repeat of run # 042**
17-Jan-05	11:43:15	Mun25_wave1_MDS	Run_044	1	1:14:56	916.99	1010.4	Accepted 705 RPM for 4 Knots speed. Launch at 3:14 and set span to 1 at 3:59
17-Jan-05	11:56:05	Mun25_wave1_MDS	Run_045	1	1:16:34	N/A	N/A	~~Accepted~~ 705 RPM for 4 Knots speed. Launch at 2:33 and set span to 1 at 3:18. Model course off to port
17-Jan-05	12:10:32	Mun25_wave1_MDS	Run_046	1	1:18:16	1008.8	1103.2	Accepted 705 RPM for 4 Knots speed. Launch at 2:33 and set span to 1 at 3:18. **Repeat of run # 045**
17-Jan-05	12:20:55	Mun25_wave1_MDS	Run_047	1	1:19:50	1092.8	1173.4	Accepted 705 RPM for 4 Knots speed. Launch at 1:55 and set span to 1 at 2:40
17-Jan-05	12:31:50	Mun25_wave1_MDS	Run_048	1	1:21:25	1162.0	1248.9	Accepted 705 RPM for 4 Knots speed. Launch at 1:18 and set span to 1 at 2:03
								Run Sequence #4, 8 knots, wave hdg 210 deg.- MUN wave
17-Jan-05	14:12:06	Mun25F_wave3_MDS	Run_049	2	0:00:00	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10. Model heading angle irregular
17-Jan-05	14:21:10	Mun25F_wave3_MDS	Run_050	2	0:01:08	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10. **Repeat of Run # 049**
17-Jan-05	14:31:59	Mun25F_wave3_MDS	Run_051	2	0:02:31	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10. **Repeat of Run # 050**
17-Jan-05	14:43:29	Mun25F_wave3_MDS	Run_052	2	0:03:45	108.69	160.47	Accepted 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10. **Repeat of Run # 051. Adjust rudder angle to 6 deg. Stbd on start**
17-Jan-05	14:55:32	Mun25F_wave3_MDS	Run_053	2	0:04:59	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 9:08 and set span to 1 at 9:53. Saturation on X & Y on QUALISYS
17-Jan-05	15:13:06	Mun25F_wave3_MDS	Run_054	2	0:06:36	157.19	205.35	Accepted 1300 RPM for 8 Knots speed. Launch at 9:08 and set span to 1 at 9:53. **Repeat of run # 53**
17-Jan-05	15:25:02	Mun25F_wave3_MDS	Run_055	2	0:08:08	194.75	244.89	Accepted 1300 RPM for 8 Knots speed. Launch at 8:47 and set span to 1 at 9:32. High yaw angle ?
17-Jan-05	15:35:48	Mun25F_wave3_MDS	Run_056	2	0:10:55	238.29	280.11	Accepted 1300 RPM for 8 Knots speed. Launch at 8:28 and set span to 1 at 9:13
18-Jan-05	8:25:00							Start Wavemaker Hydraulics and change batteries in model
18-Jan-05								Clean and rezero waveprobes
18-Jan-05								Delay starting. Problem communicating with model. 30 minute delay
18-Jan-05	9:57:38	Mun25F_wave3_MDS	Run_057	2	0:12:10	267.78	306.71	Accepted 1300 RPM for 4 Knots speed. Launch at 8:12 and set span to 1 at 8:57. Poor forward speed complications
18-Jan-05	10:13:36	Mun25F_wave3_MDS	Run_058	2	0:13:35	293.04	344.26	Accepted 1300 RPM for 8 Knots speed. Launch at 8:00 and set span to 1 at 8:45
18-Jan-05	10:25:54	Mun25F_wave3_MDS	Run_059	2	0:14:44	340.08	391.47	Accepted 1300 RPM for 8 Knots speed. Launch at 7:38 and set span to 1 at 8:23
18-Jan-05	10:39:10	Mun25F_wave3_MDS	Run_060	2	0:15:56	391.86	438.90	Accepted 1300 RPM for 8 Knots speed. Launch at 7:16 and set span to 1 at 8:01
18-Jan-05	10:51:56	Mun25F_wave3_MDS	Run_061	2	0:17:10	438.81	475.93	Accepted 1300 RPM for 8 Knots speed. Launch at 6:54 and set span to 1 at 7:39
18-Jan-05	11:06:16	Mun25F_wave3_MDS	Run_062	2	0:18:15	475.07	521.98	Accepted 1300 RPM for 8 Knots speed. Launch at 6:37 and set span to 1 at 7:22
18-Jan-05	11:19:24	Mun25F_wave3_MDS	Run_063	2	0:18:41	512.71	557.85	Accepted 1300 RPM for 8 Knots speed. Launch at 6:16 and set span to 1 at 7:01
18-Jan-05	11:30:48	Mun25F_wave3_MDS	Run_064	2	0:19:44	555.74	595.57	Accepted 1300 RPM for 8 Knots speed. Launch at 5:59 and set span to 1 at 6:44. Poor forward speed
18-Jan-05	11:44:27	Mun25F_wave3_MDS	Run_065	2	0:21:00	585.05	635.20	Accepted 1300 RPM for 8 Knots speed. Launch at 5:42 and set span to 1 at 6:27
18-Jan-05	11:59:59	Mun25F_wave3_MDS	Run_066	2	0:22:19	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 5:23 and set span to 1 at 6:08. Launch early. **No Online Data Analyze**
18-Jan-05	12:11:32	Mun25F_wave3_MDS	Run_067	2	0:23:23	633.43	681.33	Accepted 1300 RPM for 8 Knots speed. Launch at 5:23 and set span to 1 at 6:08. **Repeat of run # 066.**
18-Jan-05	12:21:34	Mun25F_wave3_MDS	Run_068	2	0:24:30	679.90	729.14	Accepted 1300 RPM for 8 Knots speed. Launch at 5:02 and set span to 1 at 5:47
18-Jan-05	13:46:25	Mun25F_wave3_MDS	Run_069	2	0:25:49	721.16	772.77	Accepted 1300 RPM for 8 Knots speed. Launch at 4:40 and set span to 1 at 5:25
18-Jan-05	13:58:03	Mun25F_wave3_MDS	Run_070	2	0:26:58	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 4:20 and set span to 1 at 5:05. **No model shaft RPM on launch**
18-Jan-05	14:08:29	Mun25F_wave3_MDS	Run_071	2	0:28:18	765.18	820.58	Accepted 1300 RPM for 8 Knots speed. Launch at 4:20 and set span to 1 at 5:06. **Repeat of run # 070**
18-Jan-05	14:20:09	Mun25F_wave3_MDS	Run_072	2	0:29:27	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 3:57 and set span to 1 at 4:42 new Skipper higher rudder angles

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 | **Proj. 2017** | **Jan. 10 - Feb. 14, 2005**

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	End Time	Comments
18-Jan-05	14:32:02	Mun25F_wave3_MDS	Run_073	2	0:30:42	863.74	910.43	Accepted 1300 RPM for 8 Knots speed. Launch at 3:36 and set span to 1 at 4:21
18-Jan-05	14:44:14	Mun25F_wave3_MDS	Run_074	2	0:31:52	905.61	953.50	Accepted 1300 RPM for 8 Knots speed. Launch at 3:16 and set span to 1 at 4:01
18-Jan-05	14:56:09	Mun25F_wave3_MDS	Run_075	2	0:33:04	945.31	999.55	Accepted 1300 RPM for 8 Knots speed. Launch at 2:56 and set span to 1 at 3:41
18-Jan-05	15:08:09	Mun25F_wave3_MDS	Run_076	2	0:34:13	997.48	1048.1	Accepted 1300 RPM for 8 Knots speed. Launch at 2:34 and set span to 1 at 3:19
18-Jan-05	15:20:12	Mun25F_wave3_MDS	Run_077	2	0:35:28	1042.0	1087.4	Accepted 1300 RPM for 8 Knots speed. Launch at 2:12 and set span to 1 at 2:57
18-Jan-05	15:31:39	Mun25F_wave3_MDS	Run_078	2	0:36:38	1081.2	1127.5	Accepted 1300 RPM for 8 Knots speed. Launch at 1:54 and set span to 1 at 2:39
19-Jan-05	8:25:00							Start Wavemaker Hydraulics and change batteries in model
19-Jan-05								Clean and rezero waveprobes
19-Jan-05	9:04:04	Mun25F_wave3_MDS	Run_079	2	0:37:49	1123.9	1173.6	Accepted 1300 RPM for 8 Knots speed. Launch at 1:35 and set span to 1 at 2:20
19-Jan-05	9:18:56	Mun25F_wave3_MDS	Run_080	2	0:38:53	1167.3	1212.5	Accepted 1300 RPM for 8 Knots speed. Launch at 1:14 and set span to 1 at 1:59
19-Jan-05	9:37:58	Mun25F_wave3_MDS	Run_081	2	0:40:08	819.64	876.63	Accepted 1300 RPM for 8 Knots speed. Launch at 3:57 and set span to 1 at 4:42. **Repeat of run # 072**
								change angle of model launcher
								Run Sequence #5, 8 knots, wave hdg 200 deg. - MUN wave
19-Jan-05	12:55:25	Mun25_wave3_MDS	Run_082	2	0:41:33	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10. West camera not recorded correctly
19-Jan-05	13:06:15	Mun25_wave3_MDS	Run_083	2	0:42:44	109.12	160.00	Accepted 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10. **Repeat of run # 082**
19-Jan-05	13:16:03	Mun25_wave3_MDS	Run_084	2	0:44:07	155.81	205.44	Accepted 1300 RPM for 8 Knots speed. Launch at 9:04 and set span to 1 at 9:49. Poor QUALISYS data.
19-Jan-05	13:27:02	Mun25_wave3_MDS	Run_085	2	0:45:56	N/A	N/A	~~ccepted~~ 1300 RPM for 8 Knots speed. Launch at 8:43 and set span to 1 at 9:28. Problem with launch. Run aborted. No online data analysis.
19-Jan-05	13:37:52	Mun25_wave3_MDS	Run_086	2	0:45:56	199.44	248.85	Accepted 1300 RPM for 8 Knots speed. Launch at 8:43 and set span to 1 at 9:28. **Repeat of run # 085**
19-Jan-05	13:49:13	Mun25_wave3_MDS	Run_087	2	0:47:07	243.12	293.43	Accepted 1300 RPM for 8 Knots speed. Launch at 8:23 and set span to 1 at 9:08
19-Jan-05	14:00:06	Mun25_wave3_MDS	Run_088	2	0:48:19	289.12	339.39	Accepted 1300 RPM for 8 Knots speed. Launch at 8:02 and set span to 1 at 8:47
19-Jan-05	14:11:02	Mun25_wave3_MDS	Run_089	2	0:49:25	335.77	386.30	Accepted 1300 RPM for 8 Knots speed. Launch at 7:41 and set span to 1 at 8:26
19-Jan-05	14:21:07	Mun25_wave3_MDS	Run_090	2	0:50:42	383.80	432.99	Accepted 1300 RPM for 8 Knots speed. Launch at 7:19 and set span to 1 at 8:04
19-Jan-05	14:32:09	Mun25_wave3_MDS	Run_091	2	0:51:51	426.65	479.21	Accepted 1300 RPM for 8 Knots speed. Launch at 6:57 and set span to 1 at 7:42
19-Jan-05	14:43:03	Mun25_wave3_MDS	Run_092	2	0:53:11	472.27	523.57	Accepted 1300 RPM for 8 Knots speed. Launch at 6:36 and set span to 1 at 7:21
19-Jan-05	14:53:14	Mun25_wave3_MDS	Run_093	2	0:54:19	519.26	566.73	Accepted 1300 RPM for 8 Knots speed. Launch at 6:15 and set span to 1 at 7:00
19-Jan-05	15:03:05	Mun25_wave3_MDS	Run_094	2	0:55:34	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 5:55 and set span to 1 at 6:40
19-Jan-05	15:14:37	Mun25_wave3_MDS	Run_095	2	0:56:39	560.74	613.60	Accepted 1300 RPM for 8 Knots speed. Launch at 5:55 and set span to 1 at 6:40. **Repeat of run # 094. Large yaw angle. No video**
19-Jan-05	15:26:49	Mun25_wave3_MDS	Run_096	2	0:56:39	610.79	656.28	Accepted 1300 RPM for 8 Knots speed. Launch at 5:33 and set span to 1 at 6:18
20-Jan-05	8:20:00							Start Wavemaker Hydraulics and change batteries in model
20-Jan-05								Clean and rezero waveprobes
20-Jan-05	9:10:29	Mun25_wave3_MDS	Run_097	2	0:57:53	649.81	694.69	Accepted 1300 RPM for 8 Knots speed. Launch at 5:14 and set span to 1 at 5:59
20-Jan-05	9:22:21	Mun25_wave3_MDS	Run_098	2	0:59:05	685.94	734.36	Accepted 1300 RPM for 8 Knots speed. Launch at 4:56 and set span to 1 at 5:41
20-Jan-05	9:34:19	Mun25_wave3_MDS	Run_099	2	1:00:14	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 4:37 and set span to 1 at 5:22
20-Jan-05	9:46:33	Mun25_wave3_MDS	Run_100	2	1:01:28	729.40	778.72	Accepted 1300 RPM for 8 Knots speed. Launch at 4:37 and set span to 1 at 5:22 **Repeat of run #99 Large Yaw Angles noted.**
20-Jan-05	9:58:11	Mun25_wave3_MDS	Run_101	2	1:02:38	771.82	817.61	Accepted 1300 RPM for 8 Knots speed. Launch at 4:17 and set span to 1 at 5:02
20-Jan-05	10:10:16	Mun25_wave3_MDS	Run_102	2	1:03:47	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 3:59 and set span to 1 at 4:44
20-Jan-05	10:22:05	Mun25_wave3_MDS	Run_103	2	1:04:52	810.80	859.09	Accepted 1300 RPM for 8 Knots speed. Launch at 3:59 and set span to 1 at 4:44 **Repeat of run #102 Large Yaw Angles**
20-Jan-05	10:34:03	Mun25_wave3_MDS	Run_104	2	1:06:08	852.92	900.43	Accepted 1300 RPM for 8 Knots speed. Launch at 3:39 and set span to 1 at 4:24
20-Jan-05	10:46:08	Mun25_wave3_MDS	Run_105	2	1:07:18	893.79	942.51	Accepted 1300 RPM for 8 Knots speed. Launch at 3:20 and set span to 1 at 4:05 Poor QUALISYS data.
20-Jan-05	10:58:20	Mun25_wave3_MDS	Run_106	2	1:08:29	936.82	985.24	Accepted 1300 RPM for 8 Knots speed. Launch at 3:01 and set span to 1 at 3:46
20-Jan-05	11:11:13	Mun25_wave3_MDS	Run_107	2	1:09:36	978.12	1025.0	Accepted 1300 RPM for 8 Knots speed. Launch at 3:26 and set span to 1 at 2:41 **No video on S.W. Camera pan with N. Beam**
20-Jan-05	11:24:06	Mun25_wave3_MDS	Run_108	2	1:10:51	1019.8	1067.1	Accepted 1300 RPM for 8 Knots speed. Launch at 2:23 and set span to 1 at 3:08 **No video on S.W. Camera pan with N. Beam**
20-Jan-05	11:36:04	Mun25_wave3_MDS	Run_109	2	1:12:03	1015.3	1064.9	Accepted 1300 RPM for 8 Knots speed. Launch at 2:23 and set span to 1 at 3:08 Poor QUALISYS data. **Repeat of run #108 Large Yaw Angles. No video on S.E. Camera pan with N. Beam**
20-Jan-05	11:48:09	Mun25_wave3_MDS	Run_110	2	1:13:11	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 2:04 and set span to 1 at 2:49 **No video on S.W. Camera pan with N. Beam**
20-Jan-05	12:00:07	Mun25_wave3_MDS	Run_111	2	1:14:21	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 1:44 and set span to 1 at 2:29 **No video on S.W. Camera pan with N. Beam**
20-Jan-05	12:12:07	Mun25_wave3_MDS	Run_112	2	1:15:34	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 1:24 and set span to 1 at 2:09 **No video on S.W. Camera pan with N. Beam**
20-Jan-05	12:45:00							Annotator board replaced to correct S.W. Camera view.
20-Jan-05	13:35:09	Mun25_wave3_MDS	Run_113	2	1:16:41	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 2:04 and set span to 1 at 2:49 **Repeat of run #110 Large Yaw Angles noted. Poor QUALISYS Data.**
20-Jan-05	13:47:13	Mun25_wave3_MDS	Run_114	2	1:17:15	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 2:04 and set span to 1 at 2:49 **Repeat of run #110 Large Yaw Angles noted. Poor QUALISYS Data.**
20-Jan-05	13:59:35	Mun25_wave3_MDS	Run_115	2	1:18:26	1056.6	1104.7	Accepted 1300 RPM for 8 Knots speed. Launch at 2:04 and set span to 1 at 2:49 **Repeat of run #110 Large Yaw Angles noted. Poor QUALISYS data.**
20-Jan-05	14:11:04	Mun25_wave3_MDS	Run_116	2	1:19:37	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 1:44 and set span to 1 at 2:29 **Repeat of run #111 Large Yaw Angles noted. Poor QUALISYS data, model tag line broke**

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 — **Proj. 2017** — **Jan. 10 - Feb. 14, 2005**

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	Online Data Analysis End Time	Comments
20-Jan-05	14:28:07	Mun25_wave3_MDS	Run_117	2	1:20:48	1099.9	1151.1	Accepted 1300 RPM for 8 Knots speed. Launch at 1:44 and set span to 1 at 2:29 **Repeat of run #111**
20-Jan-05	14:40:06	Mun25_wave3_MDS	Run_118	2	1:21:58	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 1:24 and set span to 1 at 2:09 **Repeat of run #112 Large Yaw Angles noted**
20-Jan-05	14:52:40	Mun25_wave3_MDS	Run_119	2	1:23:09	1142.7	1189.7	Accepted 1300 RPM for 8 Knots speed. Launch at 1:24 and set span to 1 at 2:09 **Repeat of run #112 Large Yaw Angles noted.**
								Run Sequence #5, 8 knots, wave hdg 200 deg. - IOT wave
20-Jan-05								
20-Jan-05	15:13:23	IOT25_wave3_drv	Run_120	3	0:00:00	107.53	156.98	Accepted 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
20-Jan-05	15:27:32	IOT25_wave3_drv	Run_121	3	0:01:08	153.57	202.12	Accepted 1300 RPM for 8 Knots speed. Launch at 9:05 and set span to 1 at 9:50
20-Jan-05	15:39:03	IOT25_wave3_drv	Run_122	3	0:02:19	198.58	245.02	Accepted 1300 RPM for 8 Knots speed. Launch at 8:44 and set span to 1 at 9:29
21-Jan-05	8:20:00							Start Wavemaker Hydraulics and change batteries in model
21-Jan-05	9:10:00							No motor control: Electronics staff found loose connection in control box - fixed
21-Jan-05	10:15:00							Clean and rezero waveprobes
21-Jan-05	10:20:01	IOT25_wave3_drv	Run_123	3	0:03:30	238.55	287.87	Accepted 1300 RPM for 8 Knots speed. Launch at 8:24 and set span to 1 at 9:09
								Safety line wrapped around model propeller - delay to address this problem.
21-Jan-05	10:41:02	IOT25_wave3_drv	Run_124	3	0:04:40	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 8:04 and set span to 1 at 8:49 **Rudder angle offset from when tag line wrapped around propeller. No online data analysis.**
21-Jan-05	11:06:51	IOT25_wave3_drv	Run_125	3	0:05:26	280.02	330.73	Accepted 1300 RPM for 8 Knots speed. Launch at 8:04 and set span to 1 at 8:49
21-Jan-05	11:18:04	IOT25_wave3_drv	Run_126	3	0:06:35	323.48	373.58	Accepted 1300 RPM for 8 Knots speed. Launch at 7:45 and set span to 1 at 8:30
21-Jan-05	11:30:02	IOT25_wave3_drv	Run_127	3	0:07:46	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 7:25 and set span to 1 at 8:10
21-Jan-05	11:42:02	IOT25_wave3_drv	Run_128	3	0:08:59	368.06	416.26	Accepted 1300 RPM for 8 Knots speed. Launch at 7:25 and set span to 1 at 8:10. **Repeat of run #127 Large Yaw Angles noted.**
21-Jan-05	11:54:03	IOT25_wave3_drv	Run_129	3	0:10:09	409.45	456.79	Accepted 1300 RPM for 8 Knots speed. Launch at 7:05 and set span to 1 at 7:50
21-Jan-05	12:06:02	IOT25_wave3_drv	Run_130	3	0:11:24	450.19	499.69	Accepted 1300 RPM for 8 Knots speed. Launch at 6:46 and set span to 1 at 7:31
21-Jan-05	12:18:03	IOT25_wave3_drv	Run_131	3	0:12:34	492.45	540.86	Accepted 1300 RPM for 8 Knots speed. Launch at 6:26 and set span to 1 at 7:11
21-Jan-05	12:30:00							Clock not sync'ed error: Keith Mews fixed
21-Jan-05	12:45:31	IOT25_wave3_drv	Run_132	3	0:13:42	532.63	582.64	Accepted 1300 RPM for 8 Knots speed. Launch at 6:07 and set span to 1 at 6:52
21-Jan-05	14:05:23	IOT25_wave3_drv	Run_133	3	0:14:53	576.26	622.82	Accepted 1300 RPM for 8 Knots speed. Launch at 5:48 and set span to 1 at 6:33
21-Jan-05	14:17:04	IOT25_wave3_drv	Run_134	3	0:16:04	618.55	660.59	Accepted 1300 RPM for 8 Knots speed. Launch at 5:29 and set span to 1 at 6:14
21-Jan-05	14:29:02	IOT25_wave3_drv	Run_135	3	0:17:15	N/A	N/A	~~Accepted~~ 1300 RPM for 8 Knots speed. Launch at 5:12 and set span to 1 at 5:57
21-Jan-05	14:41:02	IOT25_wave3_drv	Run_136	3	0:18:27	653.95	701.89	Accepted 1300 RPM for 8 Knots speed. Launch at 5:12 and set span to 1 at 5:57. **Repeat of run #135 Large Yaw Angles**
21-Jan-05	14:53:01	IOT25_wave3_drv	Run_137	3	0:19:39	694.65	739.01	Accepted 1300 RPM for 8 Knots speed. Launch at 4:52 and set span to 1 at 5:37
21-Jan-05	15:05:02	IOT25_wave3_drv	Run_138	3	0:20:49	732.63	777.82	Accepted 1300 RPM for 8 Knots speed. Launch at 4:35 and set span to 1 at 5:20
21-Jan-05	15:17:02	IOT25_wave3_drv	Run_139	3	0:21:59	773.33	823.90	Accepted 1300 RPM for 8 Knots speed. Launch at 4:17 and set span to 1 at 5:02
21-Jan-05	15:29:01	IOT25_wave3_drv	Run_140	3	0:23:09	816.58	864.39	Accepted 1300 RPM for 8 Knots speed. Launch at 3:56 and set span to 1 at 4:41
	15:40:00							Wavemaker Hydraulics shut down
								OEB shut down Jan. 24 due to poor weather & heightened potential for power failure.
								Start wavemaker hydraulics, clean and rezero all waveprobes
								Change batteries and launch model
25-Jan-05	9:25:17	IOT25_wave3_drv	Run_141	3	0:24:19	N/A	N/A	1300 RPM for 8 Knots speed. Launch at 3:37 and set span to 1 at 4:22
								Erratic steering on previous run (Run #141), repeat run follows
25-Jan-05	9:37:33	IOT25_wave3_drv	Run_142	3	0:25:01	859.52	911.60	Accepted 1300 RPM for 8 Knots speed. Launch at 3:37 and set span to 1 at 4:22
								monofiliment model tag line caught in propeller, correct and repeat previous run
25-Jan-05	10:34:34	IOT25_wave3_drv	Run_143	3	0:25:41	N/A	N/A	1300 RPM for 8 Knots speed. Launch at 3:37 and set span to 1 at 4:22
								_143 test not acceptable, Accept run _142
25-Jan-05	10:46:50	IOT25_wave3_drv	Run_144	3	0:26:10	N/A	N/A	1300 RPM for 8 Knots speed. Launch at 3:15 and set span to 1 at 4:00
								Timing gap insufficient on previous run, repeat run follows
25-Jan-05	10:58:26	IOT25_wave3_drv	Run_145	n/a	n/a	908.62	960.58	Accepted 1300 RPM for 8 Knots speed. Launch at 3:15 and set span to 1 at 4:00 - no video
25-Jan-05	11:12:39	IOT25_wave3_drv	Run_146	3	0:26:49	957.47	1004.9	Accepted 1300 RPM for 8 Knots speed. Launch at 2:52 and set span to 1 at 3:37
25-Jan-05	11:24:11	IOT25_wave3_drv	Run_147	3	0:27:42	1002.0	1051.4	Accepted 1300 RPM for 8 Knots speed. Launch at 2.32 and set span to 1 at 3:17
25-Jan-05	11:37:44	IOT25_wave3_drv	Run_148	3	0:28:28	1048.5	1100.6	Accepted 1300 RPM for 8 Knots speed. Launch at 2:10 and set span to 1 at 2:55
25-Jan-05	11:52:11	IOT25_wave3_drv	Run_149	3	0:29:04	1097.8	1149.0	Accepted 1300 RPM for 8 Knots speed. Launch at 1:47 and set span to 1 at 2:32
25-Jan-05	12:06:07	IOT25_wave3_drv	Run_150	3	0:29:40	1147.6	1195.1	Accepted 1300 RPM for 8 Knots speed. Launch at 1:25 and set span to 1 at 2:10
25-Jan-05	12:19:12	IOT25_wave3_drv	Run_151	3	0:30:19	1190.9	1237.6	Accepted 1300 RPM for 8 Knots speed. Launch at1:04 and set span to 1 at 1:49
								Shut down wavemaker hydraulics, set up for decays
								Model Roll & Pitch Decay Runs in Calm Water
25-Jan-05	13:49:39	n/a	roll_0knts_001	3	0:30:55	N/A	N/A	roll excitation at 0 knots fwd speed, three excitations
25-Jan-05	13:56:01	n/a	Pitch_0knts_001	3	0:33:05	N/A	N/A	Pitch excitation at 0 knots fwd speed, three excitations
25-Jan-05	14:01:02	n/a	roll_4knts_001	3	0:34:29	N/A	N/A	roll excitation at 4 knots fwd speed,
25-Jan-05	14:04:17	n/a	roll_4knts_002	3	???	N/A	N/A	roll excitation at 4 knots fwd speed, Video annotation shows _001

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 — Proj. 2017 — Jan. 10 - Feb. 14, 2005

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	Online Data Analysis End Time	Comments
25-Jan-05	14:07:06	n/a	roll_4knts_003	3	0:36:56	N/A	N/A	roll excitation at 4 knots fwd speed,
25-Jan-05	14:09:27	n/a	roll_8knts_001	3	0:37:37	N/A	N/A	roll excitation at 8 knots fwd speed,
25-Jan-05	14:11:27	n/a	roll_8knts_002	3	0:38:14	N/A	N/A	roll excitation at 8 knots fwd speed,
25-Jan-05	14:13:27	n/a	roll_8knts_003	3	0:38:40	N/A	N/A	roll excitation at 8 knots fwd speed, Not much excitation Repeat this run.
25-Jan-05	14:15:34	n/a	roll_8knts_004	3	0:39:08	N/A	N/A	roll excitation at 8 knots fwd speed, Video annotation has _003
25-Jan-05	14:18:10	n/a	roll_8knts_005	3	0:39:39	N/A	N/A	roll excitation at 8 knots fwd speed,
25-Jan-05	14:20:16	n/a	roll_8knts_006	3	0:40:13	N/A	N/A	roll excitation at 8 knots fwd speed, No Pitch no analysis
25-Jan-05	14:26:06	n/a	roll_8knts_007	3	0:40:46	N/A	N/A	roll excitation at 8 knots fwd speed,
								Recover model
								Reconfigure tank for following seas launch, launcher set facing east on n-s centerline
26-Jan-05								**Tank maintenance day - no testing**
27-Jan-05								**complete tank maintenance AM**
27-Jan-05								**complete tank reconfiguration, change model batteries**
27-Jan-05								clean and rezero all waveprobes
27-Jan-05								start wavemaker hydraulics
27-Jan-05								launch model, check launcher set-up and tether length.
27-Jan-05								**Run Sequence #6, 4 knots, wave hdg 65 deg. - MUN wave**
27-Jan-05	13:51:03	MUN65_WAVE2_MDS	Run_152	3	0:41:12	N/A	N/A	Accepted 680 RPM for 4 Knots speed. First launch, no delay
27-Jan-05	14:04:50	MUN65_WAVE2_MDS	Run_153	3	0:42:45	??	??	model launcher failure, no online data analysis, repeat run follows
27-Jan-05	14:18:00	MUN65_WAVE2_MDS	Run_154	3	0:43:35	186.51	270.45	Accepted 680 RPM for 4 Knots speed. Launch at 8:54 and set span to 1 at 9:39
27-Jan-05	14:32:27	MUN65_WAVE2_MDS	Run_155	3	0:44:39	263.43	337.93	Accepted 680 RPM for 4 Knots speed. Launch at 8:17 and set span to 1 at 9:20
								monofiliment model tag line tangled, correct and continue
27-Jan-05	14:54:20	MUN65_WAVE2_MDS	Run_156	3	0:45:41	N/A	N/A	680 RPM for 4 Knots speed. Launch at 7:45 and set span to 1 at 8:30, model lost heading from following wave effect, repeat run follows NO ONLINE DATA ANALYSIS
27-Jan-05	15:06:03	MUN65_WAVE2_MDS	Run_157	3	0:46:35	333.79	414.41	Accepted 680 RPM for 4 Knots speed. Launch at 7:45 and set span to 1 at 8:30, repeat of previous run
27-Jan-05	15:18:08	MUN65_WAVE2_MDS	Run_158	3	0:47:37	408.98	480.16	Accepted 680 RPM for 4 Knots speed. Launch at 7:10 and set span to 1 at 7:55
27-Jan-05	15:30:04	MUN65_WAVE2_MDS	Run_159	3	0:48:38	N/A	N/A	680 RPM for 4 Knots speed. Launch at 6:39 and set span to 1 at 7:24 delayed launch, repeat run follows
27-Jan-05								shut down wavemaker hydraulics, remove model.
28-Jan-05								clean and rezero all waveprobes
28-Jan-05								start wavemaker hydraulics
28-Jan-05								change batteries
28-Jan-05								launch model
28-Jan-05	9:27:11	MUN65_WAVE2_MDS	Run_160	3	0:49:40	476.19	552.37	Accepted 680 RPM for 4 Knots speed. Launch at 6:39 and set span to 1 at 7:24
28-Jan-05	9:39:59	MUN65_WAVE2_MDS	Run_161	3	0:50:39	542.76	622.48	Accepted 680 RPM for 4 Knots speed. Launch at 6:06 and set span to 1 at 6:51
28-Jan-05	9:51:09	MUN65_WAVE2_MDS	Run_162	3	0:51:35	619.59	698.40	Accepted 680 RPM for 4 Knots speed. Launch at 5:33 and set span to 1 at 6:18
28-Jan-05	10:03:02	MUN65_WAVE2_MDS	Run_163	3	0:52:34	693.66	768.50	Accepted 680 RPM for 4 Knots speed. Launch at 4:58 and set span to 1 at 5:43
28-Jan-05	10:15:09	MUN65_WAVE2_MDS	Run_164	3	0:53:32	763.63	838.91	Accepted 680 RPM for 4 Knots speed. Launch at 4:26 and set span to 1 at 5:11
28-Jan-05	10:28:35	MUN65_WAVE2_MDS	Run_165	3	0:54:33	832.05	909.53	Accepted 680 RPM for 4 Knots speed. Launch at 3:53 and set span to 1 at 4:38
28-Jan-05	10:43:08	MUN65_WAVE2_MDS	Run_166	3	0:55:38	907.63	984.46	Accepted 680 RPM for 4 Knots speed. Launch at 3:20 and set span to 1 at 4:05
28-Jan-05	10:56:48	MUN65_WAVE2_MDS	Run_167	3	0:56:36	982.48	1052.8	Accepted 680 RPM for 4 Knots speed. Launch at 2:45 and set span to 1 at 3:30
28-Jan-05	11:16:46	MUN65_WAVE2_MDS	Run_168	3	0:57:34	N/A	N/A	680 RPM for 4 Knots speed. Launch at 2:14 and set span to 1 at 2:59, no data overlap, run repeated below
28-Jan-05	11:28:58	MUN65_WAVE2_MDS	Run_169	3	0:58:25	1048.0	1115.7	Accepted 680 RPM for 4 Knots speed. Launch at 2:14 and set span to 1 at 2:59
28-Jan-05	11:41:48	MUN65_WAVE2_MDS	Run_170	3	0:59:21	1108.8	1188.4	Accepted 680 RPM for 4 Knots speed. Launch at 1:44 and set span to 1 at 2:29
								remove model, change batteries, one battery mount broke loose - fabrication staff repair
								launch model
28-Jan-05	14:11:22	MUN65_WAVE2_MDS	Run_171	3	1:00:29	1183.3	1254.8	Accepted 680 RPM for 4 Knots speed. Launch at 1:11 and set span to 1 at 1:56
28-Jan-05	14:20:00							OEB wave boards crashed - had to reset
28-Jan-05								**Run Sequence #7, 4 knots, wave hdg 25 deg. - MUN wave**
28-Jan-05	14:37:59	Mun25_wave1_MDS	Run_172	3	1:01:56	N/A	N/A	~~Accepted~~ 680 RPM for 4 Knots speed. Launch at 9:25 and set span to 1 at 10:10
28-Jan-05	14:50:02	Mun25_wave1_MDS	Run_173	3	1:03:34	117.74	189.83	Repeat with 660 RPM for 4 Knots speed. Launch at 9:25 and set span to 1 at 10:10 **Repeat of run #172 - use shaft speed of 660 RPM**
28-Jan-05	15:02:04	Mun25_wave1_MDS	Run_174	3	1:05:08	182.89	258.64	660 RPM for 4 Knots speed. Launch at 8:54 and set span to 1 at 9:36
28-Jan-05	15:14:03	Mun25_wave1_MDS	Run_175	3	1:06:40	248.72	322.19	660 RPM for 4 Knots speed. Launch at 8:22 and set span to 1 at 9:07
28-Jan-05	15:26:07	Mun25_wave1_MDS	Run_176	3	1:08:12	320.64	390.74	660 RPM for 4 Knots speed. Launch at 7:53 and set span to 1 at 8:38
28-Jan-05	15:38:04	Mun25_wave1_MDS	Run_177	3	1:09:49	N/A	N/A	660 RPM for 4 Knots speed. Launch at 7:21 and set span to 1 at 8:06
28-Jan-05								shut down wavemaker hydraulics, remove model.
31-Jan-05								clean and rezero all waveprobes
31-Jan-05								start wavemaker hydraulics
31-Jan-05								change batteries
31-Jan-05								launch model

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 — **Proj. 2017** — **Jan. 10 - Feb. 14, 2005**

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	End Time	Comments
31-Jan-05	9:51:23	Mun25_wave1_MDS	Run_178	3	1:11:20	383.71	459.77	Accepted 660 RPM for 4 Knots speed. Launch at 7:21 and set span to 1 at 8:06 **Repeat of run #177 - poor QUALISYS Data**
31-Jan-05	10:03:28	Mun25_wave1_MDS	Run_179	3	1:12:13	454.59	536.77	Accepted 660 RPM for 4 Knots speed. Launch at 6:49and set span to 1 at 7:44
31-Jan-05	10:15:44	Mun25_wave1_MDS	Run_180	3	1:13:12	N/A	N/A	660 RPM for 4 Knots speed. Launch at 6:13 and set span to 1 at 6:58
31-Jan-05	10:27:11	Mun25_wave1_MDS	Run_181	3	1:14:09	N/A	N/A	repeat of previous run 660 RPM for 4 Knots speed. Launch at 6:13 and set span to 1 at 6:58
31-Jan-05	10:39:48	Mun25_wave1_MDS	Run_182	3	1:15:19	531.55	603.81	Accepted repeat of previous run 660 RPM for 4 Knots speed. Launch at 6:13 and set span to 1 at 6:58
31-Jan-05	10:52:28	Mun25_wave1_MDS	Run_183	3	1:16:11	N/A	N/A	660 RPM for 4 Knots speed. Launch at 5:42and set span to 1 at 6:27
31-Jan-05	11:04:19	Mun25_wave1_MDS	Run_184	3	1:17:10	599.41	678.35	Accepted repeat of previous run 660 RPM for 4 Knots speed. Launch at 5:42and set span to 1 at 6:27
31-Jan-05	11:18:14	Mun25_wave1_MDS	Run_185	3	1:18:16	N/A	N/A	660 RPM for 4 Knots speed. Launch at 5:07 and set span to 1 at 5:52
31-Jan-05	11:31:39	Mun25_wave1_MDS	Run_186	3	1:19:14	670.46	745.87	Accepted repeat of previous run 660 RPM for 4 Knots speed. Launch at 5:07 and set span to 1 at 5:52
31-Jan-05	11:43:43	Mun25_wave1_MDS	Run_187	3	1:20:13	733.45	815.02	Accepted 660 RPM for 4 Knots speed. Launch at 4:36 and set span to 1 at 5:21
31-Jan-05	11:55:22	Mun25_wave1_MDS	Run_188	3	1:21:16	809.50	878.92	Accepted 660 RPM for 4 Knots speed. Launch at 4:04 and set span to 1 at 4:49
31-Jan-05	12:08:18	Mun25_wave1_MDS	Run_189	3	1:22:13	876.12	953.68	Accepted 660 RPM for 4 Knots speed. Launch at 3:34 and set span to 1 at 4:19
31-Jan-05	12:20:29	Mun25_wave1_MDS	Run_190	3	1:23:07	N/A	N/A	660 RPM for 4 Knots speed. Launch at 2:60 and set span to 1 at 3:45
								remove model, change batteries and re-launch
31-Jan-05	13:46:51	Mun25_wave1_MDS	Run_191	3	1:24:08	N/A	N/A	NO ONLINE DATA ANALYSIS - repeat of previous run 660 RPM for 4 Knots speed. Launch at 2:60 and set span to 1 at 3:45
								model had no power at launch, abort and repeat run below
31-Jan-05	13:58:31	Mun25_wave1_MDS	Run_192	3	1:24:35	943.16	1025.3	Accepted repeat of previous run 660 RPM for 4 Knots speed. Launch at 2:60 and set span to 1 at 3:45
31-Jan-05	14:11:31	Mun25_wave1_MDS	Run_193	3	1:25:32	N/A	N/A	repeat of previous run 660 RPM for 4 Knots speed. Launch 2:26 at and set span to 1 at 3:11
31-Jan-05	14:24:24	Mun25_wave1_MDS	Run_194	3	1:26:38	1019.8	1090.4	Accepted 660 RPM for 4 Knots speed. Launch 2:26 at and set span to 1 at 3:11
31-Jan-05	14:37:08	Mun25_wave1_MDS	Run_195	3	1:27:34	1086.7	1159.4	Accepted 660 RPM for 4 Knots speed. Launch at 1:56 and set span to 1 at 2:41
31-Jan-05	14:51:12	Mun25_wave1_MDS	Run_196	3	1:28:35	1156.7	1229.4	Accepted 660 RPM for 4 Knots speed. Launch at 1:24 and set span to 1 at 2:09
								Run Sequence #6, 4 knots, wave hdg 65 deg. - IOT wave
31-Jan-05	15:11:56	IOT65_WAVE2_MDS	Run_197	4	0:00:00	114.60	196.34	Accepted 680 RPM for 4 Knots speed. Launch at 9:25 and set span to 1 at 10:10
31-Jan-05	15:23:11	IOT65_WAVE2_MDS	Run_198	-	-	188.28	270.45	680 RPM for 4 Knots speed. Launch at 8:51 and set span to 1 at 9:36 NO Video recorded.
31-Jan-05	15:35:20	IOT65_WAVE2_MDS	Run_199	4	0:00:59	262.48	337.93	Accepted 680 RPM for 4 Knots speed. Launch at 8:17and set span to 1 at 9:02
31-Jan-05								shut down wavemaker hydraulics, remove model.
1-Feb-05								clean and rezero all waveprobes
1-Feb-05								start wavemaker hydraulics
1-Feb-05								change batteries
1-Feb-05								launch model
1-Feb-05	9:05:31	IOT65_WAVE2_MDS	Run_200	4	0:01:57	N/A	N/A	repeat of previous run, worse than before, accept _199, 680 RPM for 4 Knots speed. Launch at 8:17and set span to 1 at 9:02
1-Feb-05	9:17:50	IOT65_WAVE2_MDS	Run_201	4	0:02:57	N/A	N/A	680 RPM for 4 Knots speed. Launch at 7:45 and set span to 1 at 8:30
1-Feb-05	9:35:05	IOT65_WAVE2_MDS	Run_202	4	0:03:56	332.28	415.36	Accepted but poor QUALISYS data, repeat of previous run 680 RPM for 4 Knots speed.Launch at 7:45 and set span to 1 at 8:30
1-Feb-05	9:47:32	IOT65_WAVE2_MDS	Run_203	4	0:04:53	407.60	481.97	Accepted 680 RPM for 4 Knots speed. Launch at 7:09 and set span to 1 at 7:54
1-Feb-05	10:00:08	IOT65_WAVE2_MDS	Run_204	4	0:05:51	476.19	551.43	Accepted 680 RPM for 4 Knots speed. Launch at 6:38 and set span to 1 at 7:23
1-Feb-05	10:12:20	IOT65_WAVE2_MDS	Run_205	4	0:06:42	546.42	622.78	Accepted 680 RPM for 4 Knots speed. Launch at 6:06 and set span to 1 at 6:51
1-Feb-05	10:24:33	IOT65_WAVE2_MDS	Run_206	4	0:07:42	617.73	697.02	Accepted 680 RPM for 4 Knots speed. Launch at 5:33 and set span to 1 at 6:18
1-Feb-05	10:36:58	IOT65_WAVE2_MDS	Run_207	4	0:08:43	690.90	766.82	Accepted 680 RPM for 4 Knots speed. Launch at 4:59 and set span to 1 at 5:44
1-Feb-05	10:48:50	IOT65_WAVE2_MDS	Run_208	4	0:09:41	762.51	833.78	Accepted 680 RPM for 4 Knots speed. Launch at 4:26 and set span to 1 at 5:11
1-Feb-05	11:01:22	IOT65_WAVE2_MDS	Run_209	4	0:10:43	N/A	N/A	680 RPM for 4 Knots speed. Launch at 3:55 and set span to 1 at 4:40
1-Feb-05	11:13:53	IOT65_WAVE2_MDS	Run_210	4	0:11:46	828.22	909.61	Accepted , repeat of previous run, 680 RPM for 4 Knots speed. Launch at 3:55 and set span to 1 at 4:40
1-Feb-05	11:26:52	IOT65_WAVE2_MDS	Run_211	4	0:12:48	907.80	985.24	Accepted 680 RPM for 4 Knots speed. Launch at 3:20 and set span to 1 at 4:05
1-Feb-05	11:38:54	IOT65_WAVE2_MDS	Run_212	4	0:14:05	N/A	N/A	, poor QUALISYS data, 680 RPM for 4 Knots speed. Launch at 2:45 and set span to 1 at 3:30
1-Feb-05	11:53:09	IOT65_WAVE2_MDS	Run_213	4	0:15:04	N/A	N/A	NO ONLINE DATA ANALYSIS repeat of previous run, delayed release, repeat follows 680 RPM for 4 Knots speed. Launch at 2:45 and set span to 1 at 3:30
1-Feb-05	12:08:53	IOT65_WAVE2_MDS	Run_214	4	0:16:16	N/A	N/A	too much rudder, repeat of previous run, 680 RPM for 4 Knots speed. Launch at 2:45 and set span to 1 at 3:30
1-Feb-05	12:20:54	IOT65_WAVE2_MDS	Run_215	4	0:17:12	N/A	N/A	repeat of previous run, 680 RPM for 4 Knots speed. Launch at 2:45 and set span to 1 at 3:30
								remove model, change batteries and re-launch
								Model unresponsive following battery change, multiple re-boots and modem resets appear to have corrected problem. Continue testing tomorrow
								shut down wavemaker hydraulics,
								start up wavemaker hydraulics
2-Feb-05								Rezero probes
2-Feb-05	9:26:30	IOT65_WAVE2_MDS	Run_216	4	0:18:14	977.91	1052.1	**repeat of previous run 214,** 680 RPM for 4 Knots speed. Launch at 2:45 and set span to 1 at 3:30
2-Feb-05	9:40:25	IOT65_WAVE2_MDS	Run_217	4	0:19:47	1052.6	1131.0	680 RPM for 4 Knots speed. Launch at 2:12 and set span to 1 at 2:57
2-Feb-05	9:52:08	IOT65_WAVE2_MDS	Run_218	4	0:21:21	1126.4	1201.2	680 RPM for 4 Knots speed. Launch 1:37 at and set span to 1 at 2:22
2-Feb-05	10:04:04	IOT65_WAVE2_MDS	Run_219	4	0:22:51	1194.9	1266.2	680 RPM for 4 Knots speed. Launch at 1:05 and set span to 1 at 1:50

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 — Proj. 2017 — Jan. 10 - Feb. 14, 2005

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	Online Data Analysis End Time	Comments
								Zero Speed Drift Test - MUN Wave (A)
2-Feb-05	10:30:56	MUN25_WAVE2_MDS	Run_220	4	0:24:25	109.81	956.78	Drift test
2-Feb-05	10:44:16	MUN25_WAVE2_MDS	Run_221	4	0:32:28	700.86	1292.8	Drift test span up at 5:00
2-Feb-05								Change angle of model launcher by 10 degrees (initially launcher was set incorrectly to 5 deg.)
2-Feb-05								start up wavemaker hydraulics
2-Feb-05								change batteries, launch model
2-Feb-05								move service dock to 5 m west of n-w waveprobe due to poor QUALISYS data
2-Feb-05								attempt practice launches from new location with and without waves.
2-Feb-05								shut down wavemaker hydraulics, remove model
3-Feb-05								clean and rezero all waveprobes
3-Feb-05								start wavemaker hydraulics
3-Feb-05								change batteries
3-Feb-05								launch model
3-Feb-05								**Run Sequence #10, 8 knots, wave hdg 75 deg. - MUN wave**
3-Feb-05	9:30:29	MUN65_WAVE3_MDS	Run_222	4	0:37:37	N/A	N/A	launch problem, repeat follows 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
								tag line on model caught in propeller, remove model, clear line, re-launch and repeat last run
3-Feb-05	10:21:28	MUN65_WAVE3_MDS	Run_223	4	0:38:24	N/A	N/A	1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
								model impact east beach, model tag line broken, repair and continue
								QUALISYS data is questionable, relocate service dock to south side to avoid QUALISYS camera blockage.
3-Feb-05	11:17:29	MUN65_WAVE3_MDS	Run_224	4	0:39:11	N/A	N/A	premature launch, no online data analysis, no improvement in QUALISYS data. 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
3-Feb-05	11:29:29	MUN65_WAVE3_MDS	Run_225	4	0:39:49	N/A	N/A	1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
								remove model and reconfigure QUALISYS markers on model to improve tracking, change batteries and launch
								reposition service dock to north side 5 m west of n-w waveprobe
			new_skipper_001					shakedown runs to check QUALISYS data
3-Feb-05	13:47:25		new_skipper_002					shakedown runs to check QUALISYS data
3-Feb-05	14:03:36		new_skipper_003					
3-Feb-05	14:08:41		new_skipper_004					
3-Feb-05	14:13:18		new_skipper_005					
								QUALISYS model marker configuration improved, tracking ok, continue seakeeping testing
3-Feb-05	14:17:59	MUN65_WAVE3_MDS	Run_226	4	0:40:27	109.81	154.56	accepted 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
3-Feb-05	14:33:56	MUN65_WAVE3_MDS	Run_227	4	0:41:05	N/A	N/A	attempt to improve on previous run, take previous 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
3-Feb-05	14:45:17	MUN65_WAVE3_MDS	Run_228	4	0:41:42	N/A	N/A	model tag line caught, abort run, no online data analysis 1300 RPM for 8 Knots speed. Launch at 9:06 and set span to 1 at 9:51
3-Feb-05	15:00:02	MUN65_WAVE3_MDS	Run_229	4	0:42:13	149.78	193.62	accepted 1300 RPM for 8 Knots speed. Launch at 9:06 and set span to 1 at 9:51
3-Feb-05	15:14:59	MUN65_WAVE3_MDS	Run_230	4	0:42:50	189.40	237.69	accepted 1300 RPM for 8 Knots speed. Launch at 8:48 and set span to 1 at 9:33
3-Feb-05	15:26:37	MUN65_WAVE3_MDS	Run_231	4	0:42:28	N/A	N/A	9:13
3-Feb-05	15:36:06	MUN65_WAVE3_MDS	Run_232	4	0:43:43	235.49	283.43	accepted 1300 RPM for 8 Knots speed. Launch at 8:28 and set span to 1 at 9:13
3-Feb-05								remove model , shut down wavemaker hydraulics
4-Feb-05								change batteries, launch model
4-Feb-05								clean and rezero all waveprobes
4-Feb-05								start wavemaker hydraulics
4-Feb-05	9:19:51	MUN65_WAVE3_MDS	Run_233	4	0:44:22	280.33	332.71	accepted 1300 RPM for 8 Knots speed. Launch at 8:07 and set span to 1 at 8:52
4-Feb-05	9:31:48	MUN65_WAVE3_MDS	Run_234	4	0:45:00	327.02	370.39	1300 RPM for 8 Knots speed. Launch at 7:44 and set span to 1 at 8:29
								model speed slightly slow, configure model launcher for assisted launch
4-Feb-05	9:48:44	MUN65_WAVE3_MDS	Run_235	4	0:45:36	N/A	N/A	poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 7:26 and set span to 1 at 8:11
4-Feb-05	10:01:26	MUN65_WAVE3_MDS	Run_236	4	0:46:18	371.12	413.20	accepted poor QUALISYS at start 1300 RPM for 8 Knots speed. Launch at 7:26 and set span to 1 at 8:11
4-Feb-05	10:17:18	MUN65_WAVE3_MDS	Run_237	4	0:46:54	409.11	453.30	accepted 1300 RPM for 8 Knots speed. Launch at 7:06 and set span to 1 at 7:51
4-Feb-05	10:29:12	MUN65_WAVE3_MDS	Run_238	4	0:47:30	N/A	N/A	model travel erratic, repeat run follows 1300 RPM for 8 Knots speed. Launch at 6:48 and set span to 1 at 7:33
4-Feb-05	10:42:19	MUN65_WAVE3_MDS	Run_239	4	0:47:59	451.75	495.12	accepted 1300 RPM for 8 Knots speed. Launch at 6:48 and set span to 1 at 7:33
4-Feb-05	10:54:07	MUN65_WAVE3_MDS	Run_240	4	0:48:35	N/A	N/A	poor launch, repeat run follows 1300 RPM for 8 Knots speed. Launch at 6:28 and set span to 1 at 7:13
4-Feb-05	11:06:42	MUN65_WAVE3_MDS	Run_241	4	0:49:13	N/A	N/A	poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 6:28 and set span to 1 at 7:13
4-Feb-05	11:18:06	MUN65_WAVE3_MDS	Run_242	4	0:49:51	492.75	535.69	accepted 11300 RPM for 8 Knots speed. Launch at 6:28 and set span to 1 at 7:13
4-Feb-05	11:30:22	MUN65_WAVE3_MDS	Run_243	4	0:50:29	N/A	N/A	no online data analysis, poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 6:09 and set span to 1 at 6:54
4-Feb-05	11:42:27	MUN65_WAVE3_MDS	Run_244	4	0:51:11	533.62	582.17	accepted 1300 RPM for 8 Knots speed. Launch at 6:09 and set span to 1 at 6:54
4-Feb-05	11:54:26	MUN65_WAVE3_MDS	Run_245	4	0:51:53	582.47	620.19	accepted 1300 RPM for 8 Knots speed. Launch at 5:48and set span to 1 at 6:33
4-Feb-05	13:26:07	MUN65_WAVE3_MDS	Run_246	4	0:52:26	N/A	N/A	poor launch, repeat run follows 1300 RPM for 8 Knots speed. Launch at 5:30 and set span to 1 at 6:15
4-Feb-05	13:38:13	MUN65_WAVE3_MDS	Run_247	4	0:53:05	615.36	659.21	accepted 1300 RPM for 8 Knots speed. Launch at 5:30 and set span to 1 at 6:15

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 | Proj. 2017 | Jan. 10 - Feb. 14, 2005

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	Online Data Analysis End Time	Comments
4-Feb-05	13:50:44	MUN65_WAVE3_MDS	Run_248	4	0:53:42	N/A	N/A	poor headingangle, repeat run follows 1300 RPM for 8 Knots speed. Launch at 5:12 and set span to 1 at 5:57
4-Feb-05	14:02:08	MUN65_WAVE3_MDS	Run_249	4	0:54:19	652.14	693.31	accepted 1300 RPM for 8 Knots speed. Launch at 5:12 and set span to 1 at 5:57
4-Feb-05	14:14:08	MUN65_WAVE3_MDS	Run_250	4	0:54:57	N/A	N/A	no video recorded, no online data analysis, poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 4:56 and set span to 1 at 5:41
4-Feb-05	14:26:53	MUN65_WAVE3_MDS	Run_251	4	0:55:35	690.21	729.61	accepted 1300 RPM for 8 Knots speed. Launch at 4:56 and set span to 1 at 5:41
4-Feb-05	14:38:53	MUN65_WAVE3_MDS	Run_252	4	0:56:10	N/A	N/A	high yaw angle, repeat run follows 1300 RPM for 8 Knots speed. Launch at 4:40 and set span to 1 at 5:25
4-Feb-05	14:50:53	MUN65_WAVE3_MDS	Run_253	4	0:56:51	N/A	N/A	monofiliment tag line snagged, repeat run follows 1300 RPM for 8 Knots speed. Launch at 4:40 and set span to 1 at 5:25
4-Feb-05	15:02:21	MUN65_WAVE3_MDS	Run_254	4	0:57:14	N/A	N/A	drag on tag line, repeat run follows 1300 RPM for 8 Knots speed. Launch at 4:40 and set span to 1 at 5:25
4-Feb-05	15:15:29	MUN65_WAVE3_MDS	Run_255	4	0:57:54	726.25	763.24	accepted 1300 RPM for 8 Knots speed. Launch at 4:40 and set span to 1 at 5:25
4-Feb-05	15:27:21	MUN65_WAVE3_MDS	Run_256	4	0:58:33	N/A	N/A	monofiliment tag line snagged, repeat run follows 1300 RPM for 8 Knots speed. Launch at 4:24 and set span to 1 at 5:09
4-Feb-05	15:40:51	MUN65_WAVE3_MDS	Run_257	4	1:00:35	760.01	802.18	accepted 1300 RPM for 8 Knots speed. Launch at 4:24 and set span to 1 at 5:09
4-Feb-05								Remove model, shut down wavemaker hydraulics
7-Feb-05								**ice tank freeze - no testing in OEB to reduce power demand**
8-Feb-05								**ice tank freeze continues in AM - no testing in OEB**
8-Feb-05								**changing wavemaker hydraulic pump in PM - no testing in OEB**
9-Feb-05								change batteries, launch model
9-Feb-05								clean and rezero all waveprobes
9-Feb-05								start wavemaker hydraulics
9-Feb-05								model drive motor unresponsive, found problem with power connection, correct and continue - 1 hour delay
9-Feb-05	9:52:32	MUN65_WAVE3_MDS	Run_258	4	1:01:12	798.30	842.83	accepted 1300 RPM for 8 Knots speed. Launch at 4:06 and set span to 1 at 4:51
9-Feb-05	10:04:58	MUN65_WAVE3_MDS	Run_259	4	1:01:48	842.96	887.41	accepted 1300 RPM for 8 Knots speed. Launch at 3:47 and set span to 1 at 4:32
9-Feb-05	10:16:02	MUN65_WAVE3_MDS	Run_260	4	1:02:28	885.04	924.14	accepted 1300 RPM for 8 Knots speed. Launch at 3:26 and set span to 1 at 4:11
9-Feb-05	10:28:06	MUN65_WAVE3_MDS	Run_261	4	1:03:08	921.47	963.46	accepted 1300 RPM for 8 Knots speed. Launch at 3:09 and set span to 1 at 3:54
9-Feb-05	10:42:19	MUN65_WAVE3_MDS	Run_262	4	1:03:47	956.35	1003.5	accepted 1300 RPM for 8 Knots speed. Launch at 2:51 and set span to 1 at 3:36
9-Feb-05	10:55:04	MUN65_WAVE3_MDS	Run_263	4	1:04:26	1001.4	1045.1	accepted 1300 RPM for 8 Knots speed. Launch at 2:32 and set span to 1 at 3:17
9-Feb-05	11:07:25	MUN65_WAVE3_MDS	Run_264	4	1:05:05	N/A	N/A	yaw angle excessive, repeat run follows 1300 RPM for 8 Knots speed. Launch at 2:13 and set span to 1 at 2:58
9-Feb-05	11:22:24	MUN65_WAVE3_MDS	Run_265	4	1:05:40	1041.5	1078.7	accepted 1300 RPM for 8 Knots speed. Launch at 2:13 and set span to 1 at 2:58
9-Feb-05	11:36:35	MUN65_WAVE3_MDS	Run_266	4	1:06:18	N/A	N/A	tag line snagged. Repeat run follows 1300 RPM for 8 Knots speed. Launch at 1:58 and set span to 1 at 2:43
9-Feb-05	11:50:18	MUN65_WAVE3_MDS	Run_267	4	1:06:58	N/A	N/A	yaw angle excessive, poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 1:58 and set span to 1 at 2:43
9-Feb-05	12:07:08	MUN65_WAVE3_MDS	Run_268	4	1:07:35	N/A	N/A	QUALISYS data dropouts excessive at run mid point, repeat test with earlier launch timing to attempt to clean up track.1300 RPM for 8 Knots speed. Launch at 1:58 and set span to 1 at 2:43
9-Feb-05	12:23:07	MUN65_WAVE3_MDS	Run_269	4	1:08:12	1071.9	1103.7	Accepted 1300 RPM for 8 Knots speed. Launch at 2:06 and set span to at 2:51
9-Feb-05	12:39:03	MUN65_WAVE3_MDS	Run_270	4	1:08:50	1100.4	1141.1	Accepted 1300 RPM for 8 Knots speed. Launch at 1:46 and set span to 1 at 2:31
9-Feb-05	12:51:32	MUN65_WAVE3_MDS	Run_271	4	1:09:29	N/A	N/A	excessive yaw angle noted, repeat follows 1300 RPM for 8 Knots speed. Launch at 1:29 and set span to 1 at 2:14
9-Feb-05	13:03:36	MUN65_WAVE3_MDS	Run_272	4	1:10:07	1142.4	1180.5	Accepted 1300 RPM for 8 Knots speed. Launch at 1:29 and set span to 1 at 2:14
9-Feb-05	13:15:11	MUN65_WAVE3_MDS	Run_273	4	1:10:42	1178.8	1212.8	Accepted 1300 RPM for 8 Knots speed. Launch at 1:10 and set span to 1 at 1:55
9-Feb-05								Remove model and set up for next tank configuration - change model launcher angle
9-Feb-05								Shut down wavemaker hydraulics
10-Feb-05								change batteries, launch model
10-Feb-05								clean and rezero all waveprobes
10-Feb-05								start wavemaker hydraulics
10-Feb-05								**Run Sequence #8, 8 knots, wave hdg 65 deg. - MUN wave**
10-Feb-05	9:12:59	MUN65_WAVE3_MDS	Run_274	4	1:11:20	107.70	146.93	Accepted 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
10-Feb-05	9:25:25	MUN65_WAVE3_MDS	Run_275	4	1:11:57	N/A	N/A	excessive yaw angle noted, repeat run follows 1300 RPM for 8 Knots speed. Launch at 9:10 and set span to 1 at 9:55
10-Feb-05	9:38:01	MUN65_WAVE3_MDS	Run_276	4	1:12:37	144.69	188.23	Accepted 1300 RPM for 8 Knots speed. Launch at 9:10 and set span to 1 at 9:55
10-Feb-05	9:52:20	MUN65_WAVE3_MDS	Run_277	4	1:13:14	183.75	230.23	Accepted 1300 RPM for 8 Knots speed. Launch at 8:51 and set span to 1 at 9:36
10-Feb-05	10:06:22	MUN65_WAVE3_MDS	Run_278	4	1:13:52	226.74	272.26	Accepted 1300 RPM for 8 Knots speed. Launch at 8:31 and set span to 1 at 9:16
10-Feb-05	10:19:13	MUN65_WAVE3_MDS	Run_279	4	1:14:27	267.91	312.96	Accepted 1300 RPM for 8 Knots speed. Launch at 8:12 and set span to 1 at 8:57
10-Feb-05	10:31:24	MUN65_WAVE3_MDS	Run_280	4	1:15:11	308.05	354.61	Accepted 1300 RPM for 8 Knots speed. Launch at 7:53 and set span to 1 at 8:38
10-Feb-05	10:43:03	MUN65_WAVE3_MDS	Run_281	4	1:15:51	349.44	394.41	Accepted 1300 RPM for 8 Knots speed. Launch at 7:34and set span to 1 at 8:19
10-Feb-05	10:55:38	MUN65_WAVE3_MDS	Run_282	4	1:16:29	393.89	440.75	Accepted 1300 RPM for 8 Knots speed. Launch at 7:15 and set span to 1 at 8:00
10-Feb-05	11:07:15	MUN65_WAVE3_MDS	Run_283	4	1:17:05	438.73	484.08	Accepted 1300 RPM for 8 Knots speed. Launch at 6:54 and set span to 1 at 7:39
10-Feb-05	11:19:41	MUN65_WAVE3_MDS	Run_284	4	1:17:37	480.81	530.77	Accepted 1300 RPM for 8 Knots speed. Launch at 6:33 and set span to 1 at 7:18
10-Feb-05	11:31:33	MUN65_WAVE3_MDS	Run_285	4	1:18:13	526.42	578.07	Accepted 1300 RPM for 8 Knots speed. Launch at 6:12 and set span to 1 at 6:57
10-Feb-05	11:43:36	MUN65_WAVE3_MDS	Run_286	4	1:18:50	N/A	N/A	No online data analysis, pa system failure, no launch command, no model launch, repeat follows 1300 RPM for 8 Knots speed. Launch at 5:50 and set span to 1 at 6:35
10-Feb-05	11:55:40	MUN65_WAVE3_MDS	Run_287	4	1:21:27	575.31	625.97	Accepted 1300 RPM for 8 Knots speed. Launch at 5:50 and set span to 1 at 6:35
10-Feb-05	12:07:12	MUN65_WAVE3_MDS	Run_288	4	1:22:06	621.79	671.84	Accepted 1300 RPM for 8 Knots speed. Launch at 5:28 and set span to 1 at 6:13
10-Feb-05	12:19:26	MUN65_WAVE3_MDS	Run_289	4	1:22:43	668.18	719.05	Accepted 1300 RPM for 8 Knots speed. Launch at 5:06 and set span to 1 at 5:51

CCGA Atlantic Swell Seakeeping Experiments

Model #IOT651 — Proj. 2017 — Jan. 10 - Feb. 14, 2005

Offshore Engineering Basin

Date	NF Time	Wave Drive Signal	File Name	V. Tape #	Vid Time	Online Data Analysis Start Time	End Time	Comments
								lost model launcer weight - recover using magnet from boat - minor delay
								remove model, change batteries and re-launch
10-Feb-05	14:01:37	MUN65_WAVE3_MDS	Run_290	5	0:00:00	715.30	767.08	Accepted 1300 RPM for 8 Knots speed. Launch at 4:44 and set span to 1 at 5:29
10-Feb-05	14:14:13	MUN65_WAVE3_MDS	Run_291	5	0:00:40	765.23	813.47	Accepted 1300 RPM for 8 Knots speed. Launch at 4:22 and set span to 1 at 5:07
10-Feb-05	14:27:51	MUN65_WAVE3_MDS	Run_292	5	0:01:18	811.14	860.16	Accepted 1300 RPM for 8 Knots speed. Launch at 4:01 and set span to 1 at 4:46
10-Feb-05	14:39:23	MUN65_WAVE3_MDS	Run_293	5	0:01:57	856.89	905.82	Accepted 1300 RPM for 8 Knots speed. Launch at 3:39and set span to 1 at 4:24
10-Feb-05	14:52:17	MUN65_WAVE3_MDS	Run_294	5	0:02:35	900.65	948.93	Accepted 1300 RPM for 8 Knots speed. Launch at 3:18 and set span to 1 at 4:03
10-Feb-05	15:05:28	MUN65_WAVE3_MDS	Run_295	5	0:03:09	944.75	992.39	Accepted 1300 RPM for 8 Knots speed. Launch at 2:58 and set span to 1 at 3:43
10-Feb-05	15:17:20	MUN65_WAVE3_MDS	Run_296	5	0:03:46	990.18	1038.0	Accepted 1300 RPM for 8 Knots speed. Launch at 2:38 and set span to 1 at 3:23
10-Feb-05	15:30:17	MUN65_WAVE3_MDS	Run_297	5	0:04:24	1035.2	1083.0	Accepted 1300 RPM for 8 Knots speed. Launch at 2:16 and set span to 1 at 3:01
10-Feb-05								Remove model, shut down wavemaker hydraulics
11-Feb-05								change batteries, launch model
11-Feb-05								clean and rezero all waveprobes, start wavemaker hydraulics
11-Feb-05	9:23:49	MUN65_WAVE3_MDS	Run_298	5	0:05:00	1080.2	1126.3	Accepted 1300 RPM for 8 Knots speed. Launch at 1:56 and set span to 1 at 2:41
11-Feb-05	9:36:17	MUN65_WAVE3_MDS	Run_299	5	0:05:38	1123.5	1170.4	Accepted 1300 RPM for 8 Knots speed. Launch at 1:35 and set span to 1 at 2:20
11-Feb-05	9:49:21	MUN65_WAVE3_MDS	Run_300	5	0:06:17	1165.0	1211.9	Accepted 1300 RPM for 8 Knots speed. Launch at 1:15 and set span to 1 at 2:00
								Run Sequence #9, 8 knots, wave hdg 25 deg. - MUN wave
11-Feb-05	10:14:25	MUN25_WAVE3_MDS	Run_301	5	0:06:52	110.85	157.11	Accepted 1300 RPM for 8 Knots speed. Launch at 9:25 and set span to 1 at 10:10
11-Feb-05	10:26:56	MUN25_WAVE3_MDS	Run_302	5	0:07:27	154.05	199.19	Accepted 1300 RPM for 8 Knots speed. Launch at 9:05 and set span to 1 at 9:50
11-Feb-05	11:40:59	MUN25_WAVE3_MDS	Run_303	5	0:08:03	195.05	243.64	Accepted 1300 RPM for 8 Knots speed. Launch at 8:46 and set span to 1 at 9:31
11-Feb-05	10:52:58	MUN25_WAVE3_MDS	Run_304	5	0:08:44	239.89	287.87	Accepted 1300 RPM for 8 Knots speed. Launch at 8:25and set span to 1 at 9:10
11-Feb-05	11:03:53	MUN25_WAVE3_MDS	Run_305	5	0:09:21	285.37	331.80	Accepted 1300 RPM for 8 Knots speed. Launch at 8:04 and set span to 1 at 8:49
11-Feb-05	11:15:18	MUN25_WAVE3_MDS	Run_306	5	0:10:00	N/A	N/A	excessive yaw angle, repeat run follows 1300 RPM for 8 Knots speed. Launch at 7:44 and set span to 1 at 8:29
11-Feb-05	11:27:33	MUN25_WAVE3_MDS	Run_307	5	0:10:33	328.66	375.87	Accepted 1300 RPM for 8 Knots speed. Launch at 7:44 and set span to 1 at 8:29
11-Feb-05	11:39:03	MUN25_WAVE3_MDS	Run_308	5	0:11:14	N/A	N/A	large QUALISYS dropouts noted, repeat run follows 1300 RPM for 8 Knots speed. Launch at 7:24 and set span to 1 at 8:09
11-Feb-05	11:51:09	MUN25_WAVE3_MDS	Run_309	5	0:11:56	371.55	421.01	Accepted 1300 RPM for 8 Knots speed. Launch at 7:24 and set span to 1 at 8:09
11-Feb-05	12:03:06	MUN25_WAVE3_MDS	Run_310	5	0:12:34	418.20	464.51	Accepted 1300 RPM for 8 Knots speed. Launch at 7:03 and set span to 1 at 7:48
11-Feb-05	12:15:16	MUN25_WAVE3_MDS	Run_311	5	0:13:11	461.10	509.95	Accepted 1300 RPM for 8 Knots speed. Launch at 6:43 and set span to 1 at 7:28
11-Feb-05	13:48:34	MUN25_WAVE3_MDS	Run_312	5	0:13:50	507.02	556.47	Accepted 1300 RPM for 8 Knots speed. Launch at 6:21 and set span to 1 at 7:06
11-Feb-05	14:00:44	MUN25_WAVE3_MDS	Run_313	5	0:14:29	552.29	597.82	Accepted 1300 RPM for 8 Knots speed. Launch at 5:60 and set span to 1 at 6:45
11-Feb-05	14:12:31	MUN25_WAVE3_MDS	Run_314	5	0:15:08	591.65	637.61	Accepted 1300 RPM for 8 Knots speed. Launch at 5:41 and set span to 1 at 6:26
11-Feb-05	14:24:34	MUN25_WAVE3_MDS	Run_315	5	0:15:43	633.56	679.99	Accepted 1300 RPM for 8 Knots speed. Launch at 5:22 and set span to 1 at 6:07
11-Feb-05	14:36:49	MUN25_WAVE3_MDS	Run_316	5	0:16:19	678.48	723.15	Accepted 1300 RPM for 8 Knots speed. Launch at 5:03 and set span to 1 at 5:48
11-Feb-05	14:49:44	MUN25_WAVE3_MDS	Run_317	5	0:16:55	719.91	767.25	Accepted 1300 RPM for 8 Knots speed. Launch at 4:43 and set span to 1 at 5:28
11-Feb-05	15:01:32	MUN25_WAVE3_MDS	Run_318	5	0:17:29	N/A	N/A	poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 4:22 and set span to 1 at 5:07
11-Feb-05	15:14:01	MUN25_WAVE3_MDS	Run_319	5	0:18:09	N/A	N/A	still poor QUALISYS data, accept previous run 1300 RPM for 8 Knots speed. Launch at 4:22 and set span to 1 at 5:07
								Segment from 767 s to 810 s missing ??
11-Feb-05	15:26:04	MUN25_WAVE3_MDS	Run_320	5	0:18:46	810.07	856.93	Accepted 1300 RPM for 8 Knots speed. Launch at 4:01 and set span to 1 at 4:46
11-Feb-05								Remove model, shut down wavemaker hydraulics
14-Feb-05								change batteries, launch model
14-Feb-05								clean and rezero all waveprobes, start wavemaker hydraulics
14-Feb-05	9:28:26	MUN25_WAVE3_MDS	Run_321	5	0:19:24	854.60	901.47	poor QUALISYS data, repeat run follows 1300 RPM for 8 Knots speed. Launch at 3:40 and set span to 1 at 4:25
14-Feb-05	9:40:53	MUN25_WAVE3_MDS	Run_322	5	0:20:02	854.30	905.48	Accepted 1300 RPM for 8 Knots speed. Launch at 3:40 and set span to 1 at 4:25
14-Feb-05	9:53:31	MUN25_WAVE3_MDS	Run_323	5	0:20:39	N/A	N/A	no data overlap, no online data analysis, repeat run follows 1300 RPM for 8 Knots speed. Launch at 3:18 and set span to 1 at 4:03
14-Feb-05	10:05:27	MUN25_WAVE3_MDS	Run_324	5	0:21:19	903.41	948.33	Accepted 1300 RPM for 8 Knots speed. Launch at 3:18 and set span to 1 at 4:03
14-Feb-05	10:17:22	MUN25_WAVE3_MDS	Run_325	5	0:21:52	945.23	990.11	Accepted 1300 RPM for 8 Knots speed. Launch at 2:58 and set span to 1 at 3:43
14-Feb-05	10:29:23	MUN25_WAVE3_MDS	Run_326	5	0:22:27	987.61	1030.5	Accepted 1300 RPM for 8 Knots speed. Launch at 2:39 and set span to 1 at 3:24
14-Feb-05	10:41:34	MUN25_WAVE3_MDS	Run_327	5	0:23:05	1026.6	1072.4	Accepted 1300 RPM for 8 Knots speed. Launch at 2:20 and set span to 1 at 3:05
14-Feb-05	10:53:51	MUN25_WAVE3_MDS	Run_328	5	0:23:42	1069.4	1120.1	Accepted 1300 RPM for 8 Knots speed. Launch at 2:01 and set span to 1 at 2:46
14-Feb-05	11:08:21	MUN25_WAVE3_MDS	Run_329	5	0:24:19	1117.0	1161.5	Accepted 1300 RPM for 8 Knots speed. Launch at 1:38 and set span to 1 at 2:23
14-Feb-05	11:21:26	MUN25_WAVE3_MDS	Run_330	5	0:24:58	1159.1	1208.5	Accepted 1300 RPM for 8 Knots speed. Launch at 1:19 and set span to 1 at 2:04
								Zero Speed Beam Drift Test - MUN Wave (B)
14-Feb-05	11:43:09	MUN25_WAVE2_MDS	Run_331	5	0:24:38	120.00	750.00	Drift test, beam condition
14-Feb-05	11:56:20	MUN25_WAVE2_MDS	Run_332	5	0:32:20	747.00	1220.0	re-start drift at 5:00 remaining
								Zero Speed Beam Drift Test - IOT Wave
14-Feb-05	12:13:31	IOT25_WAVE2_MDS	Run_333	5	0:37:27	120.00	430.00	Drift test, beam condition
14-Feb-05	12:22:28	IOT25_WAVE2_MDS	Run_334	5	0:40:47	470.00	1023.0	re-start drift at 7:00 remaining
14-Feb-05	12:31:23	IOT25_WAVE2_MDS	Run_335	5	0:45:23	1020.0	1220.0	re-start drift at 2:30 remaining
								gap of about 40 s in data
NOTE:	For a model forward speed of 4 knots full scale, shaft speed set at 660 - 705 RPM in waves.							Remove model, shut down wavemaker hydraulics
	For a model forward speed of 8 knots full scale, shaft speed set at Max RPM (~1280 RPM) - actually achieved 7.2 - 7.5 knots full scale.							
	Heading angle = 180 deg. is defined as a head sea.							
	Two waves were matched - an IOT defined wave as well as a MUN defined wave.							
	Origin of QUALISYS was base of aft marker for Seq. # 1-3 & at CG for remainder of test program.							

APPENDIX F: TEST PLAN AND MODEL LAUNCH POSITIONS

Model #IOT651 - CCGA Atlantic Swell - scale 1:4.697 **Safer Fishing Vessel Seakeeping** **Proj. 2017**

TEST PLAN **V 4.0** **Model #IOT651** **Nov. 4, 2004**

Seakeeping Experiments in Irregular Waves:

Calm Water Fwd. Speed: 4 knots FS, 0.9495 m/s MS
Calm Water Fwd. Speed: 8 knots FS, 1.899 m/s MS

Roll decay tests to be carried out at the following 3 forward speeds:

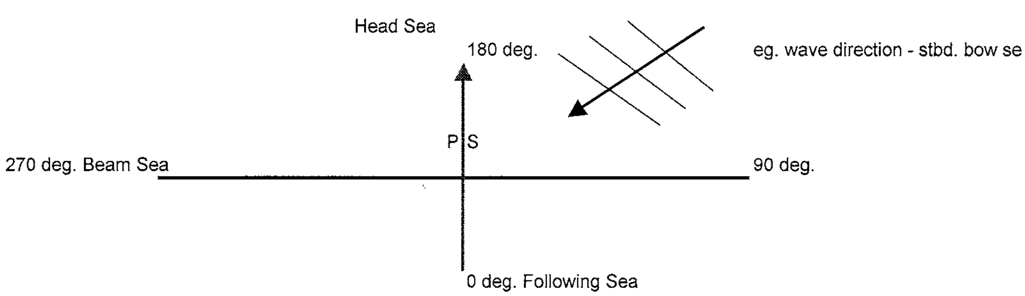
1) 0 m/s
2) 4 knots full scale, 0.9495 m/s model scale
3) 8 knots full scale, 1.899 m/s model scale

Note:
#1) Excited model roll motion three times for each speed.
#2) QUALISYS used to provide time series of roll angle. If just roll period is required, the roll rate signal from the MotionPak II is satisfactory.
#3) Model in roll stimulated by manually depressing main deck at max beam.

File Name	Sequence #	Wave	Wave Direction (deg. from south wall)	Fwd. Speed FS knots	Fwd. Speed MS m/s	Heading Angle deg.	Comments
	1	WAVE 1F	25	4	0.9495	205	(actually 155 deg heading)
	3	WAVE 1	25	4	0.9495	210	
	2	WAVE 2F	65	4	0.9495	245	(actually 115 deg. heading)
	6	WAVE 2	65	4	0.9495	65	repeated with IOT wave
	7	WAVE 1	25	4	0.9495	25	
	5	WAVE 3	25	8	1.899	200	repeated with IOT wave
	4	WAVE 3F	25	8	1.899	210	(actually 150 deg. heading)
	10	WAVE 3	65	8	1.899	75	
	8	WAVE 3	65	8	1.899	60	
	9	WAVE 3	25	8	1.899	20	
		WAVE 2	25	drift	drift	90	repeated with IOT wave

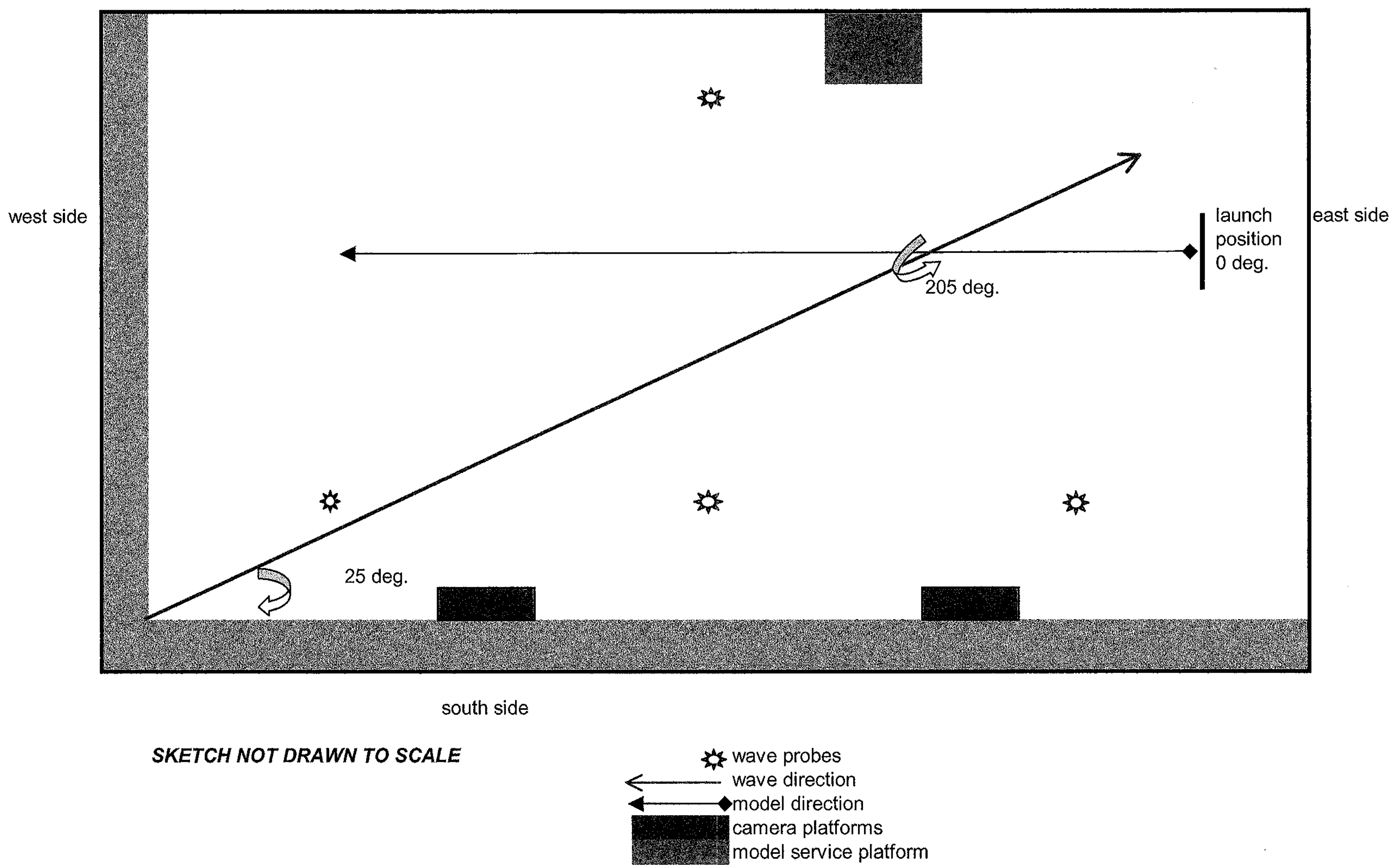
NOTE:180 deg. is defined as a head sea. Wave acting counterclockwise from 0 deg. (Following Sea) acting on stern.
FS = Full Scale MS = Model Scale
All waves are irreg. waves generated 25 & 65 deg. relative to the south wall of OEB.
Model is tethered with stern restraint line and gravity launch system used for all runs.
Use manual steering.
All blanking walls out for all runs.
18 min FS repeat period (8.31 minutes, 498 s MS) for all tests. This will require roughly 22 segments (8 knots), 11 segments (4 knots) per run.
12 minutes wait time between runs.
Beam sea drift run permited to drift untethered. Model will probably drift off 90 deg. Start next segment at 90 deg. to wave.
Carry out zero speed drift run when convenient in test program.
Should not be necessary to move any wave probes off station during testing.
Adjust shaft rps to achieve nominally correct forward speed.
(I.e. rather than determine calm water shaft speed & keep this shaft speed regardless of heading angle)

WAVE 1: Wave measured at 08:00. Match for 25 deg. from south wall only.
WAVE 2: Wave measured at 09:30. Match for both 25 & 65 deg. from south wall.
WAVE 3: Wave measured at 10:00 - with amplitude reduced by 20% Match for both 25 & 65 deg. from south wall.
WAVE#F: means WAVE# flipped to enable optimum model course.
Match waves for 18 minutes. Match waves to non-directional (C11) spectrum.
Use alpha1 ('mean') for wave direction. Match 10 waves - one set of 5 with diff. Spreading angle for each freq. component & standard IOT irr. wave spectrum.



Safer Fishing Vessel Seakeeping **Proj. 2017** **CCGA Atlantic Swell Seakeeping Experiments**

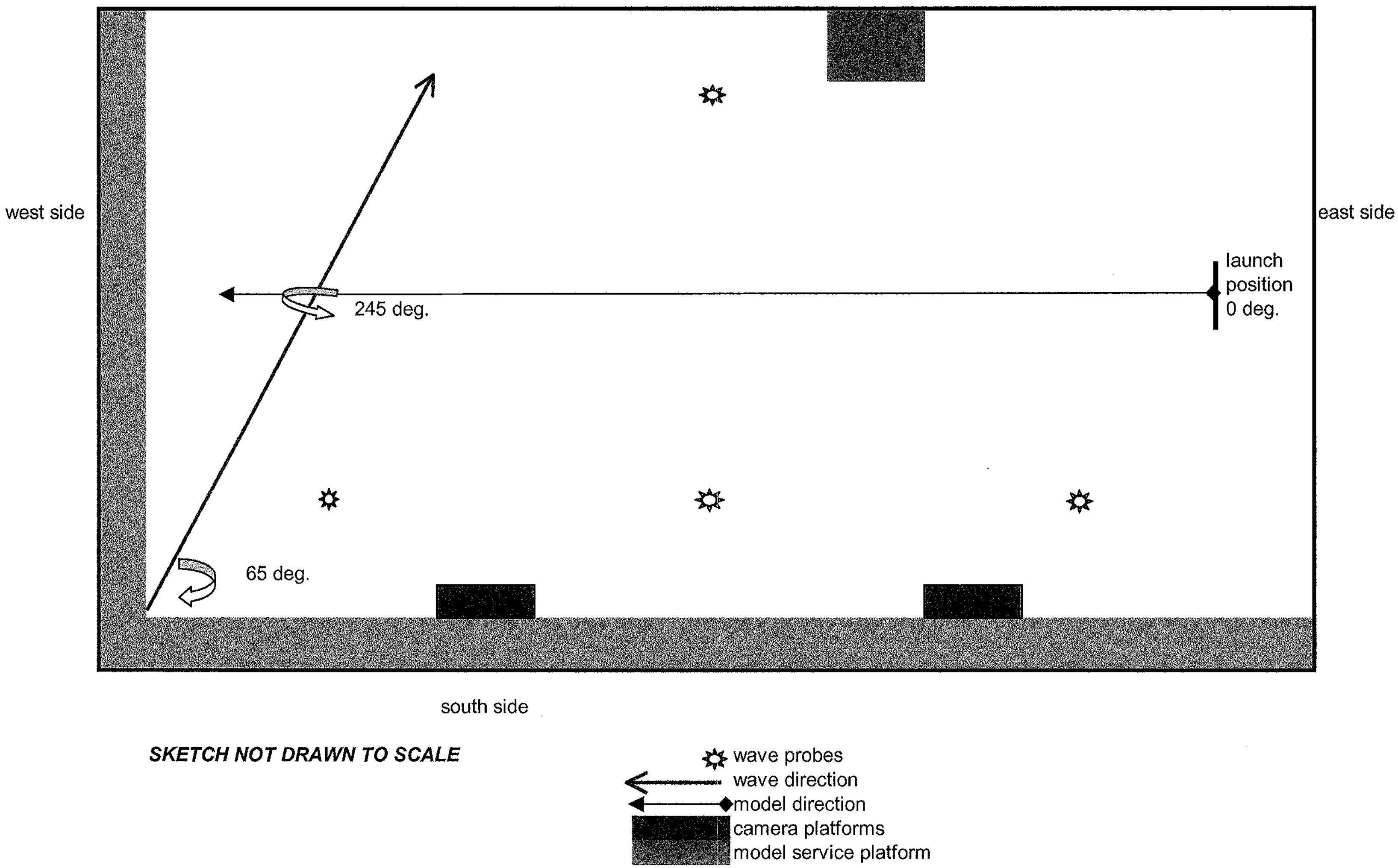
Heading Angle with respect to waves = 155 deg.
Forward Speed = 4 kts. **0.9495 m/s** **Run Sequence #1**
Wave 1F



SKETCH NOT DRAWN TO SCALE

Safer Fishing Vessel Seakeeping | Proj. 2017 | CCGA Atlantic Swell Seakeeping Experiments

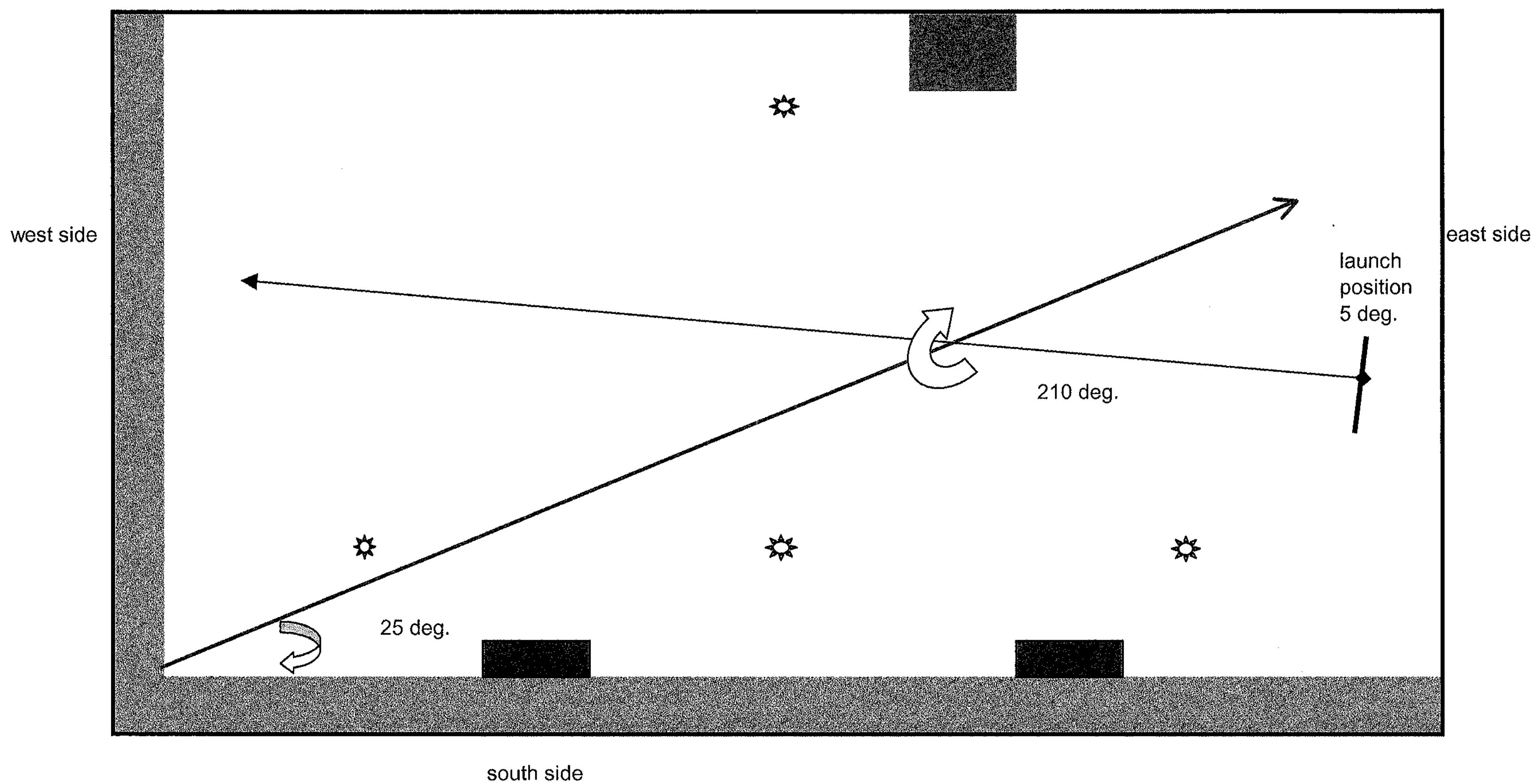
Heading Angle with respect to waves = 115 deg.
Forward Speed = 4 kts. 0.9495 m/s Run Sequence #2
Wave 2F



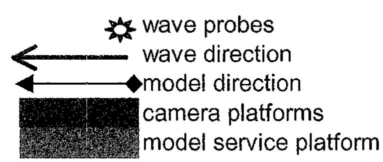
SKETCH NOT DRAWN TO SCALE

Safer Fishing Vessel Seakeeping | Proj. 2017 | CCGA Atlantic Swell Seakeeping Experiments

Heading Angle with respect to waves = 210 deg.
Forward Speed = 4 kts. 0.9495 m/s Run Sequence #3
Wave 1

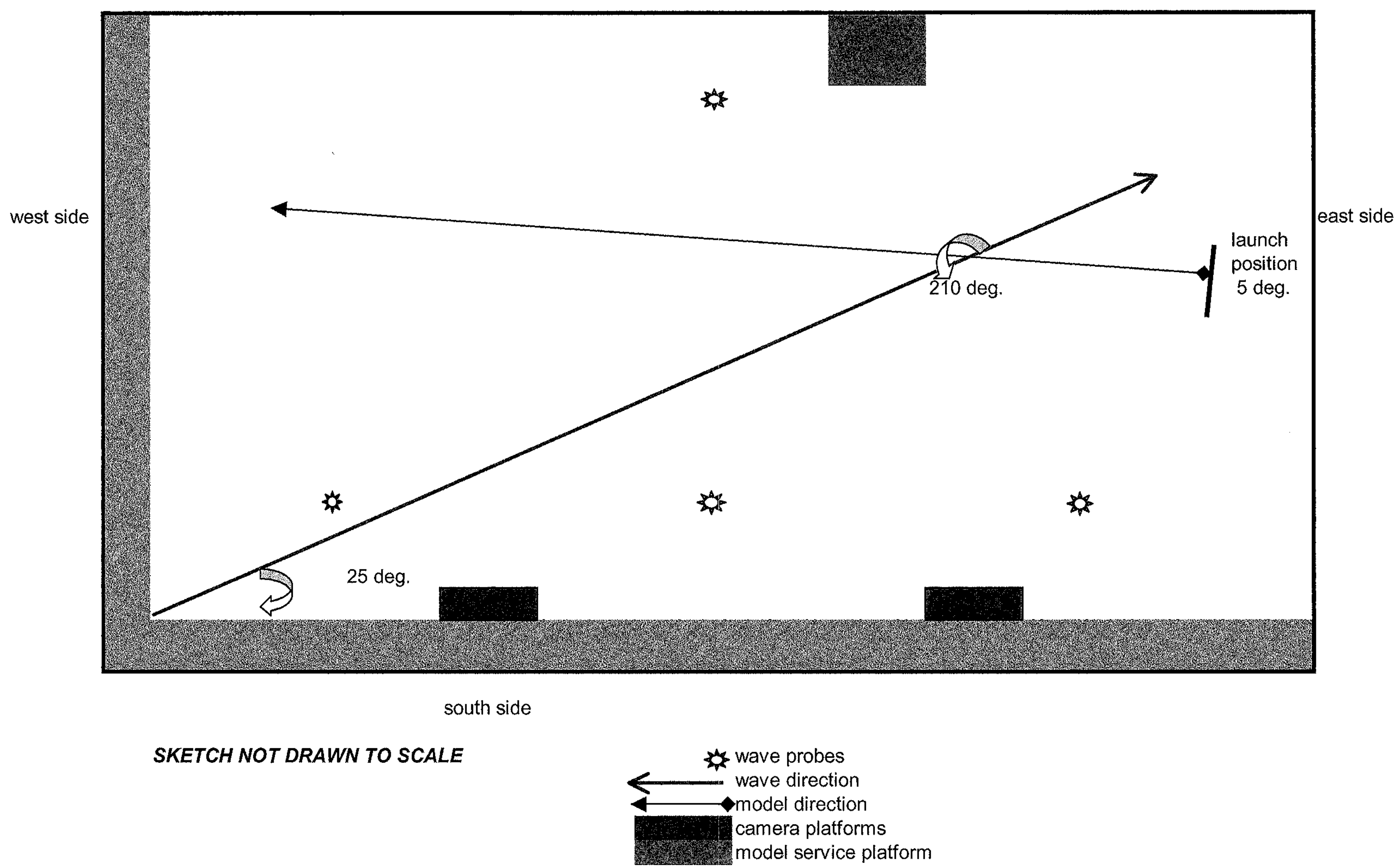


SKETCH NOT DRAWN TO SCALE



Safer Fishing Vessel Seakeeping | Proj. 2017 | CCGA Atlantic Swell Seakeeping Experiments

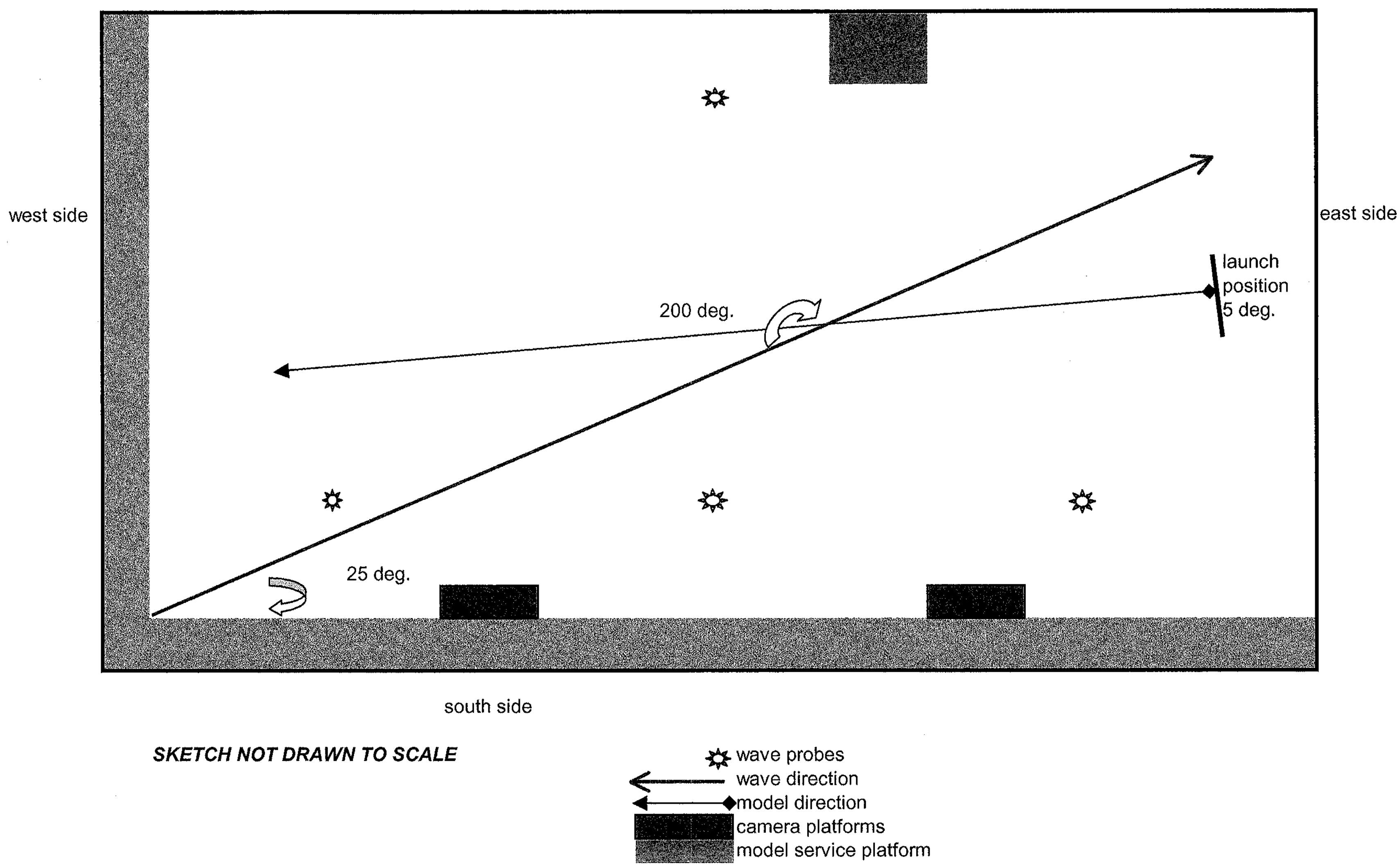
Heading Angle with respect to waves = 150 deg.
Forward Speed = 8 kts. 1.899 m/s Run Sequence #4
Wave 3F



SKETCH NOT DRAWN TO SCALE

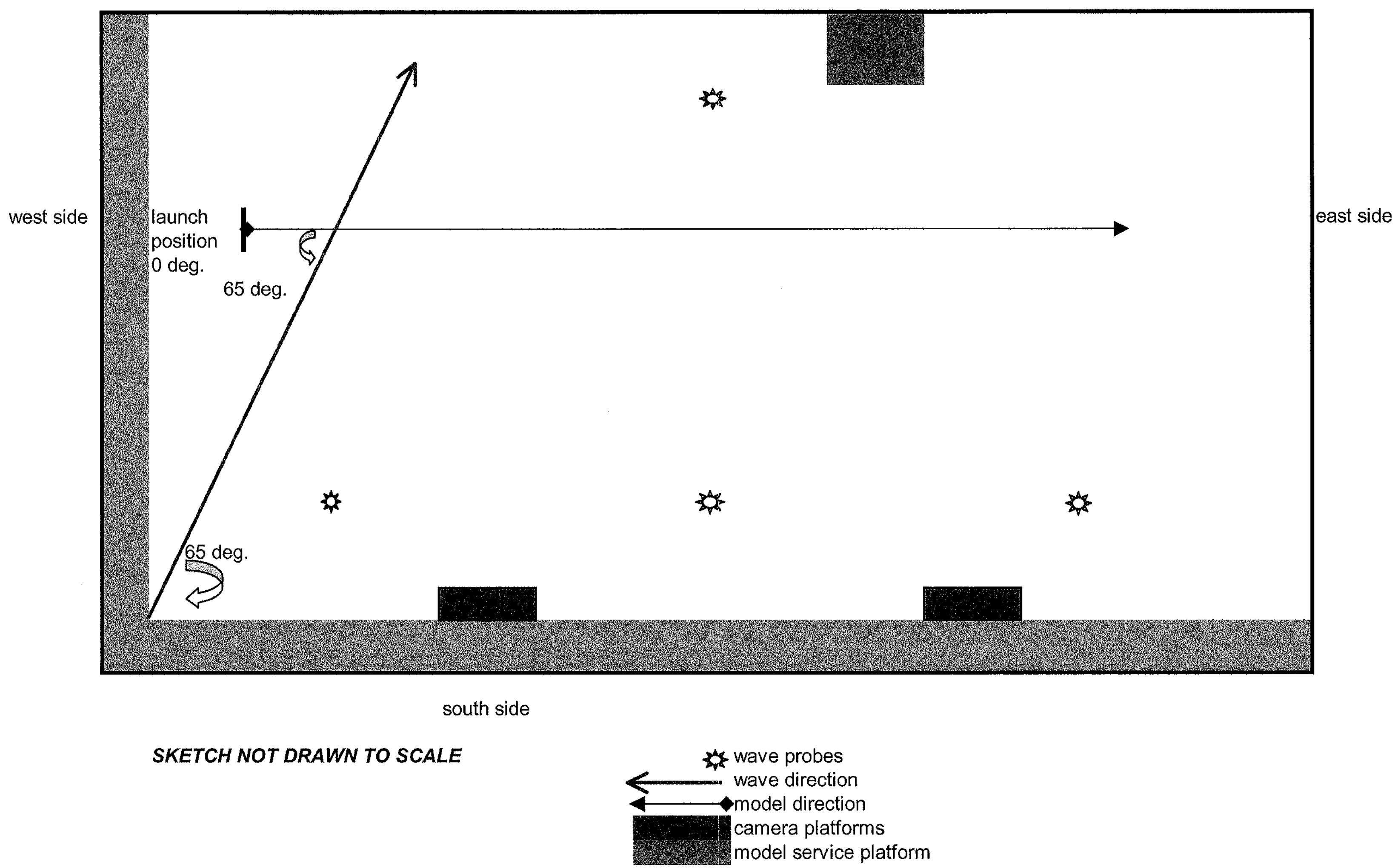
Safer Fishing Vessel Seakeeping | Proj. 2017 | CCGA Atlantic Swell Seakeeping Experiments

Heading Angle with respect to waves = 200 deg.
Forward Speed = 8 kts. 1.899 m/s Run Sequence #5
Wave 3



Safer Fishing Vessel Seakeeping   Proj. 2017   CCGA Atlantic Swell Seakeeping Experiments

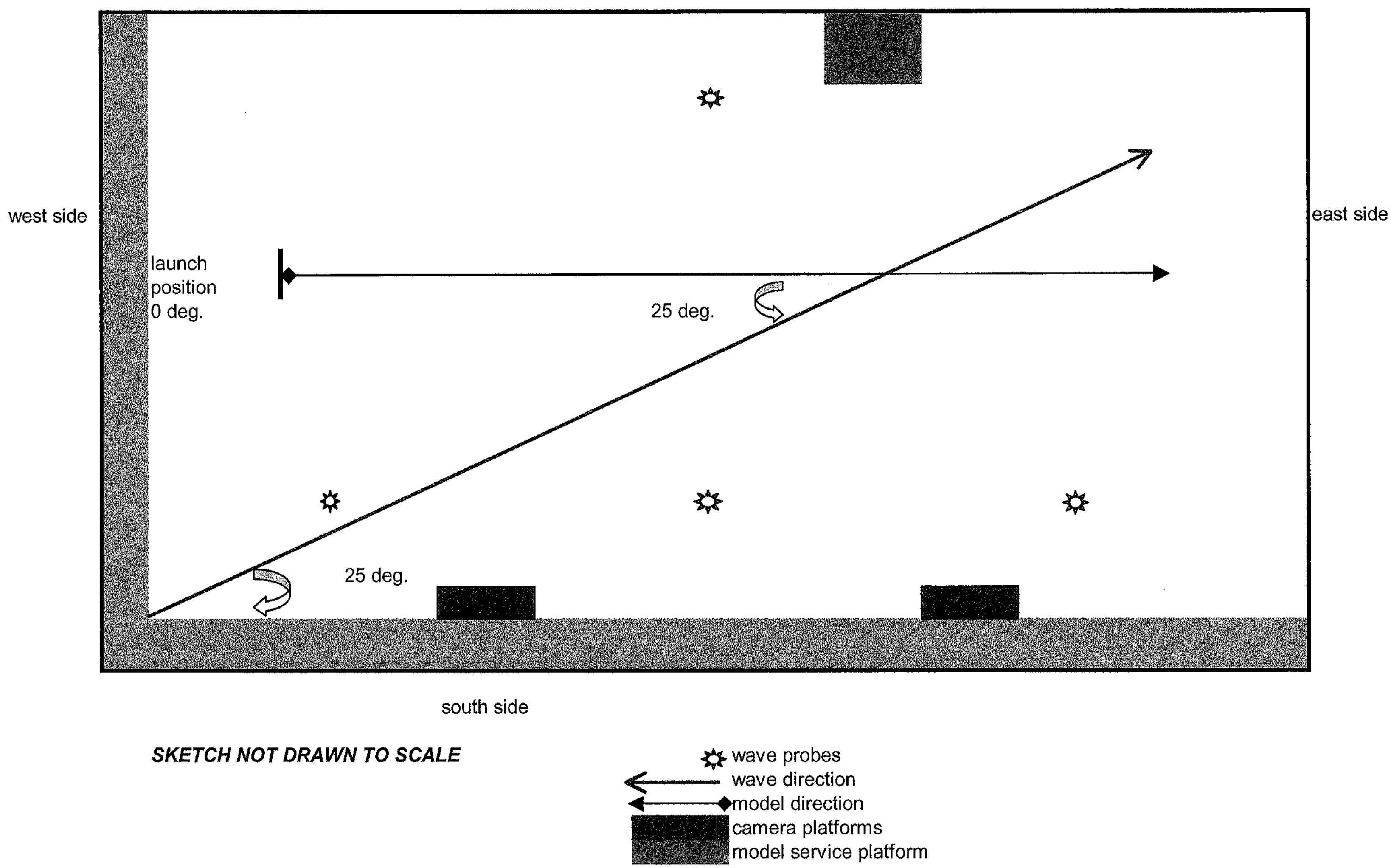
Heading Angle with respect to waves = 65 deg.
Forward Speed = 4 kts.   0.9495 m/s   Run Sequence #6
Wave 2



SKETCH NOT DRAWN TO SCALE

Safer Fishing Vessel Seakeeping **Proj. 2017** **CCGA Atlantic Swell Seakeeping Experiments**

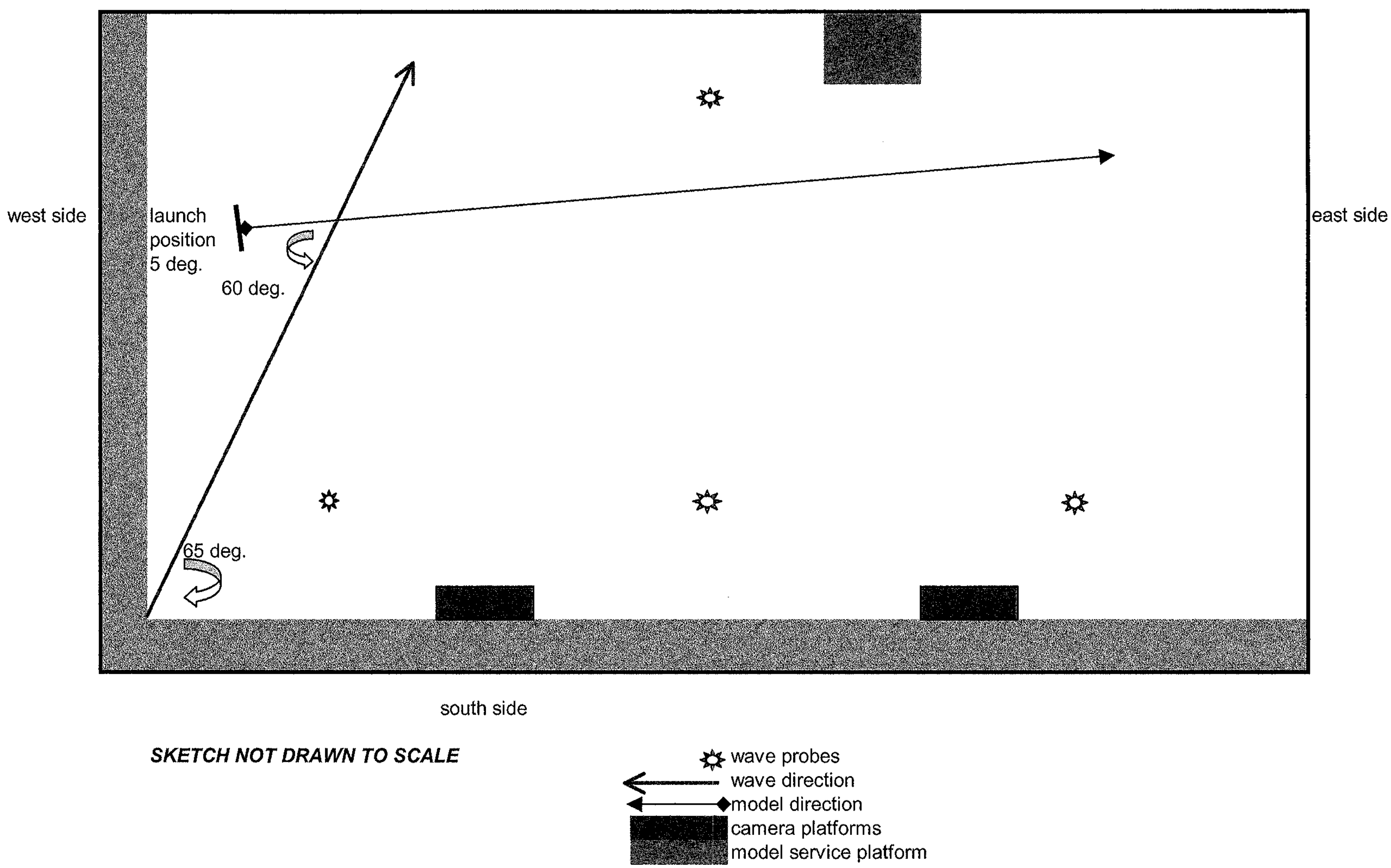
Heading Angle with respect to waves = 25 deg.
Forward Speed = 4 kts. **0.9495 m/s** **Run Sequence #7**
Wave 1



SKETCH NOT DRAWN TO SCALE

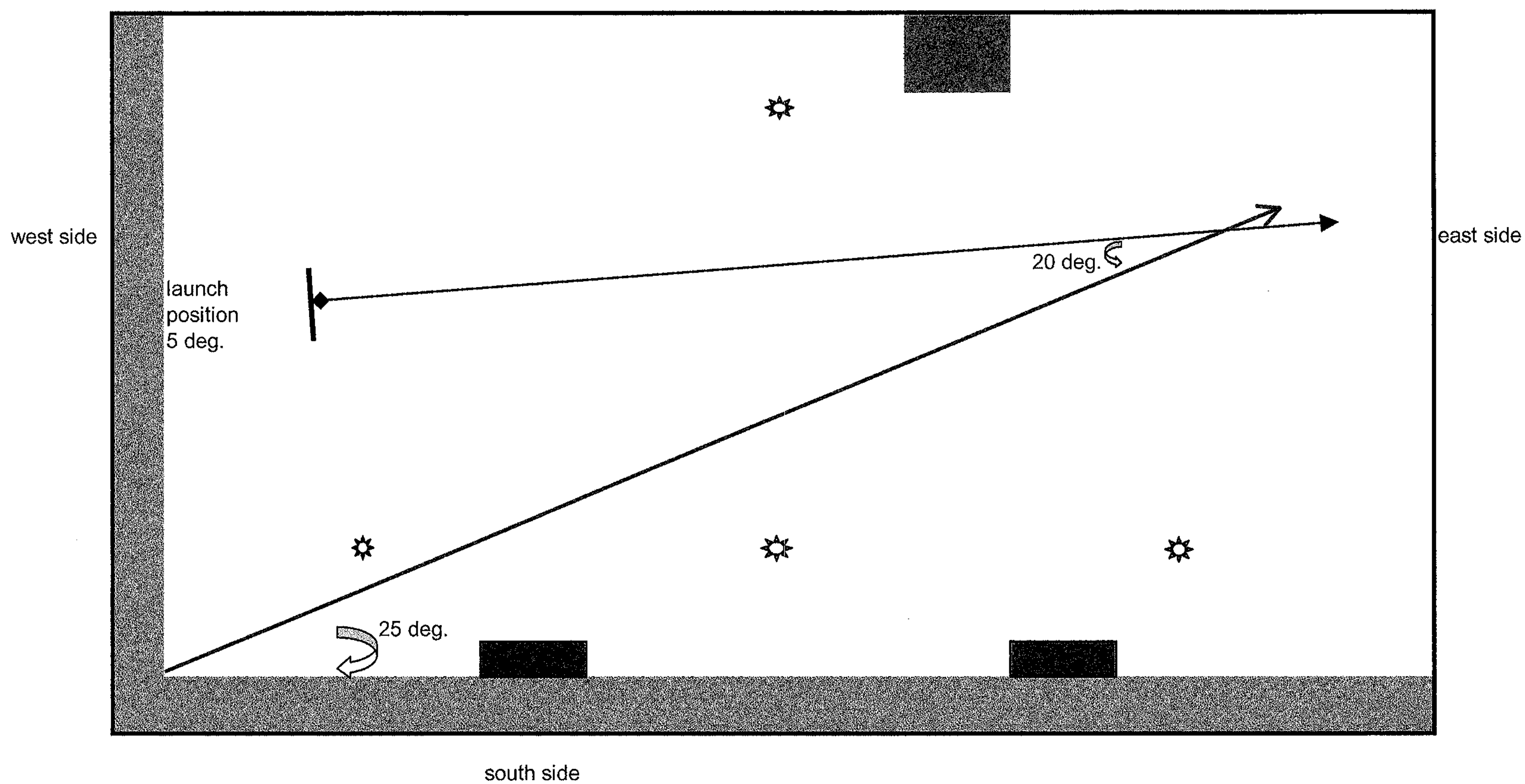
Safer Fishing Vessel Seakeeping | Proj. 2017 | CCGA Atlantic Swell Seakeeping Experiments

Heading Angle with respect to waves = 60 deg.
Forward Speed = 8 kts. 1.899 m/s Run Sequence #8
Wave 3

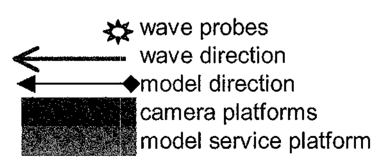


Safer Fishing Vessel Seakeeping **Proj. 2017** **CCGA Atlantic Swell Seakeeping Experiments**

Heading Angle with respect to waves = 20 deg.
Forward Speed = 8 kts. **1.899 m/s** **Run Sequence #9**
Wave 3

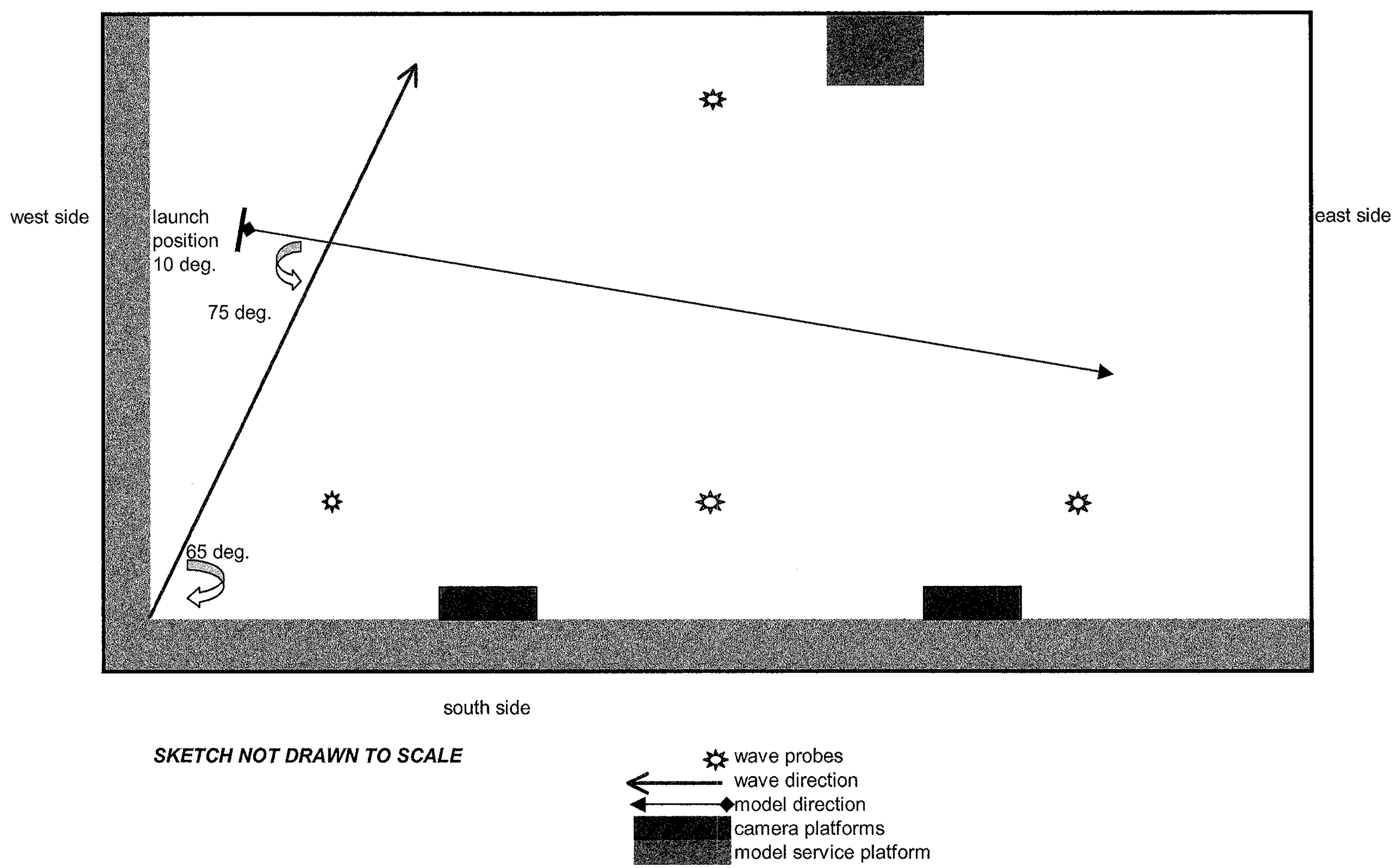


SKETCH NOT DRAWN TO SCALE



Safer Fishing Vessel Seakeeping   Proj. 2017   CCGA Atlantic Swell Seakeeping Experiments

Heading Angle with respect to waves = 75 deg.
Forward Speed = 8 kts.   1.899 m/s   Run Sequence #10
Wave 3

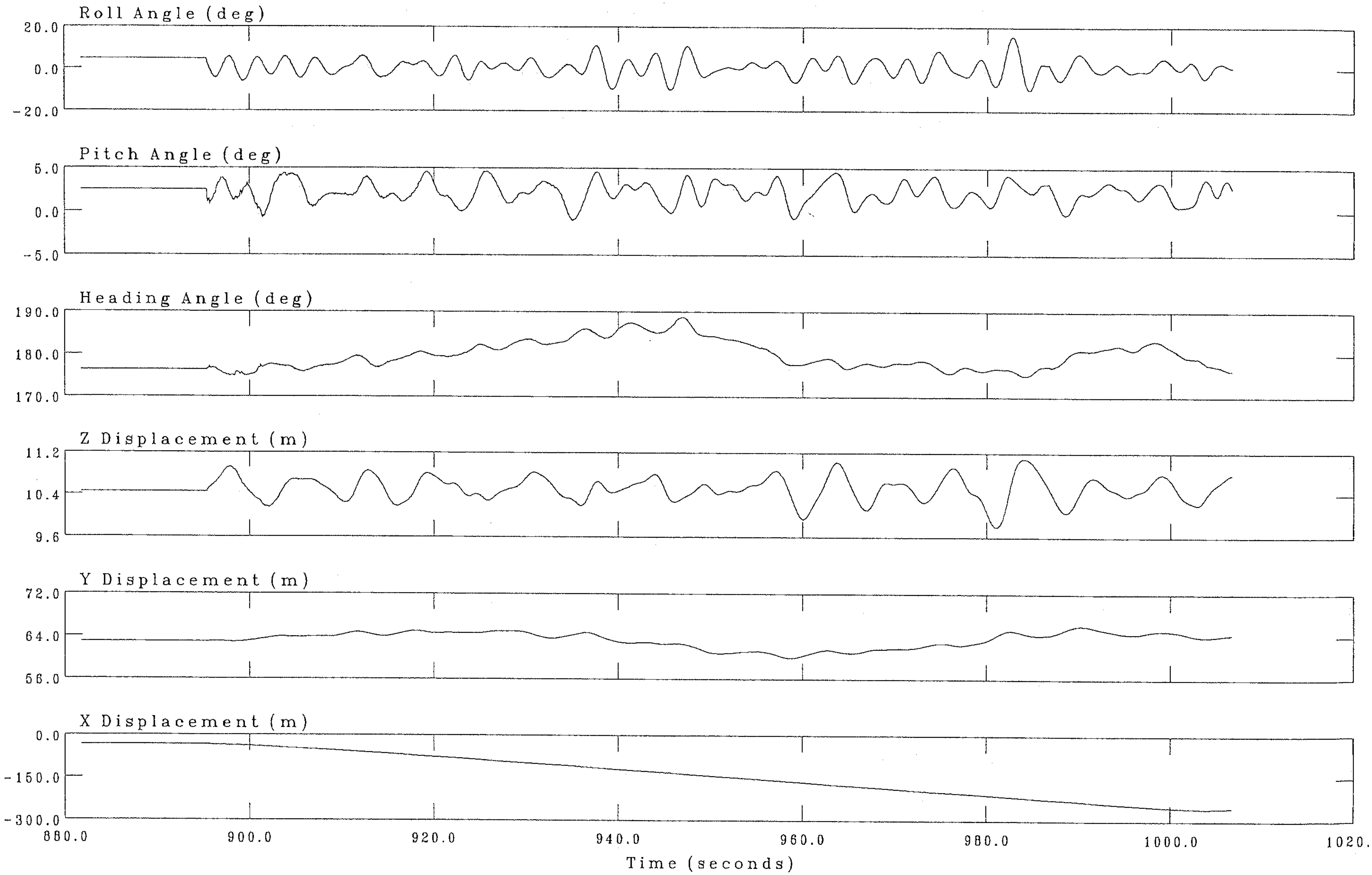


APPENDIX G: EXAMPLE ONLINE ANALYSIS DATA PRODUCT

Fishing Vessel Safety
CCGA Atlantic Swell Seakeeping Tests

IOT

Analyzed: 01-FEB-2005 11:37:38
Acquired: 1-FEB-2005 11:26:52



National Research Council Canada
Institute for Ocean Technology

GENERATED BY: OEB	CHECKED BY:	APPROVED BY:

Figure 1 run_211

Fishing Vessel Safety
CCGA Atlantic Swell Seakeeping Tests

IOT

Analyzed: 01-FEB-2005 11:37:46
Acquired: 1-FEB-2005 11:26:52

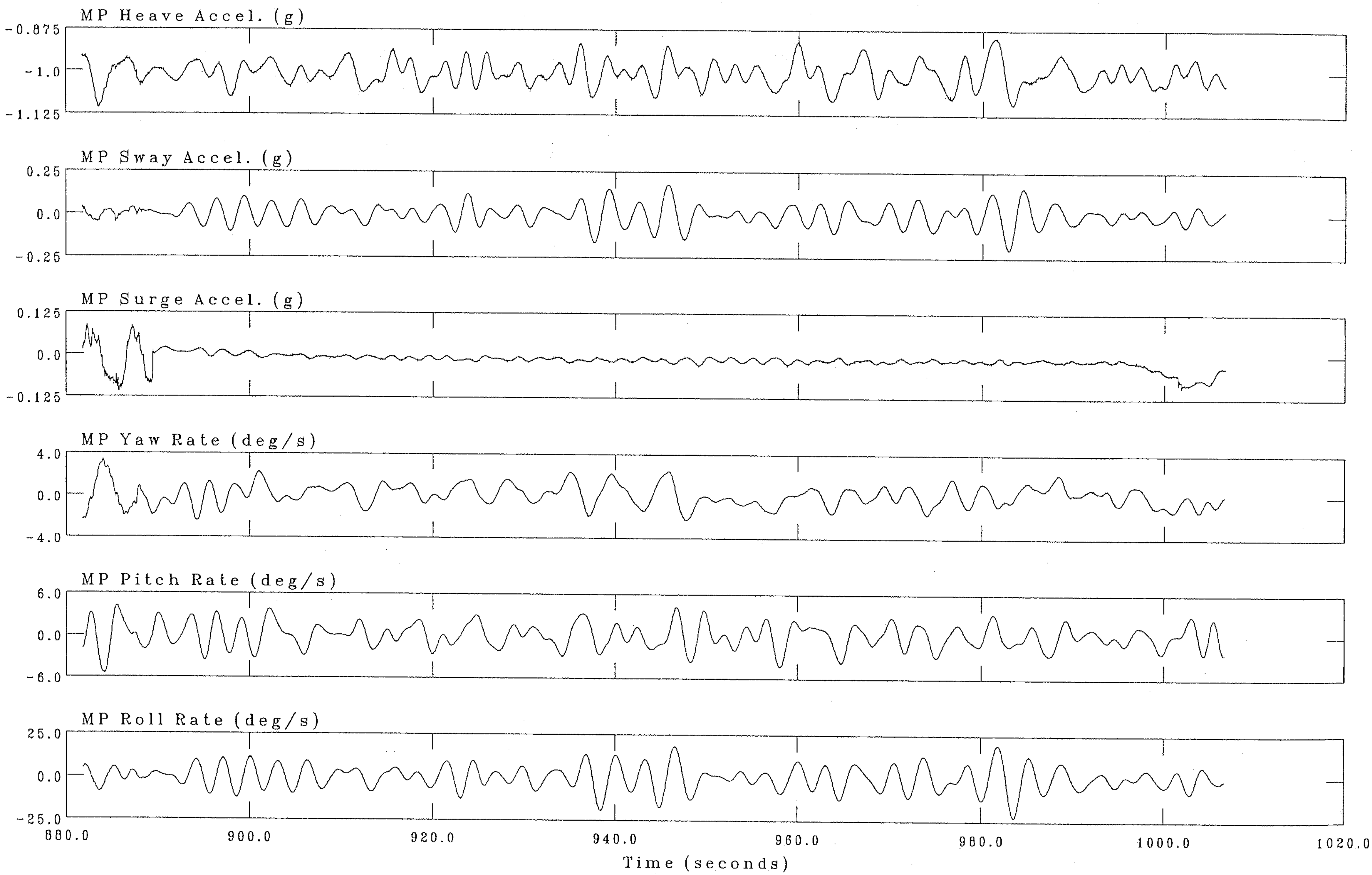


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Figure 2 run_211

Fishing Vessel Safety
CCGA Atlantic Swell Seakeeping Tests

IOT

Analyzed: 01-FEB-2005 11:37:49
Acquired: 1-FEB-2005 11:26:52

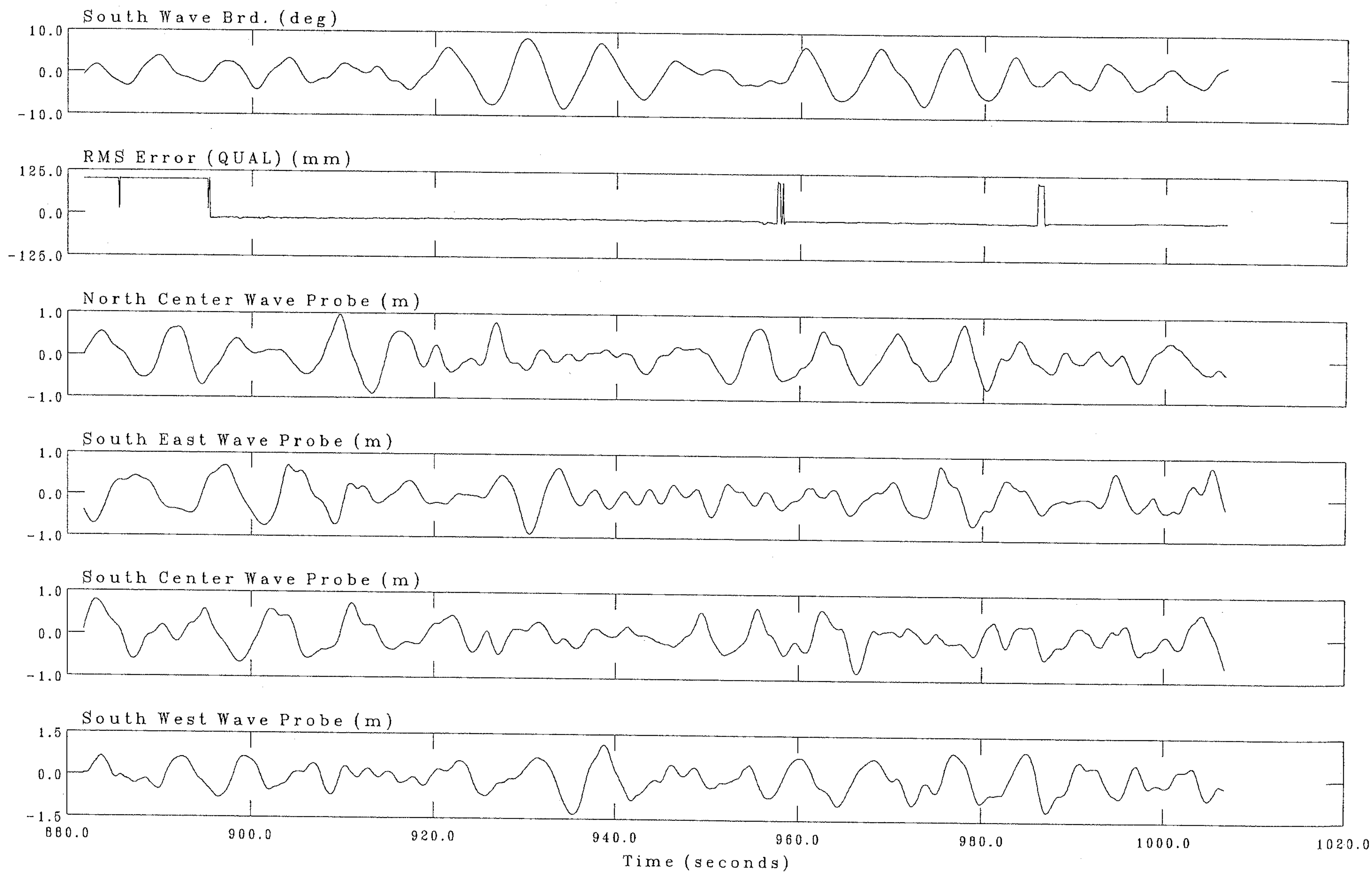

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Figure 3 run_211

Fishing Vessel Safety
CCGA Atlantic Swell Seakeeping Tests IOT

Analyzed: 01-FEB-2005 11:37:54
Acquired: 1-FEB-2005 11:26:52

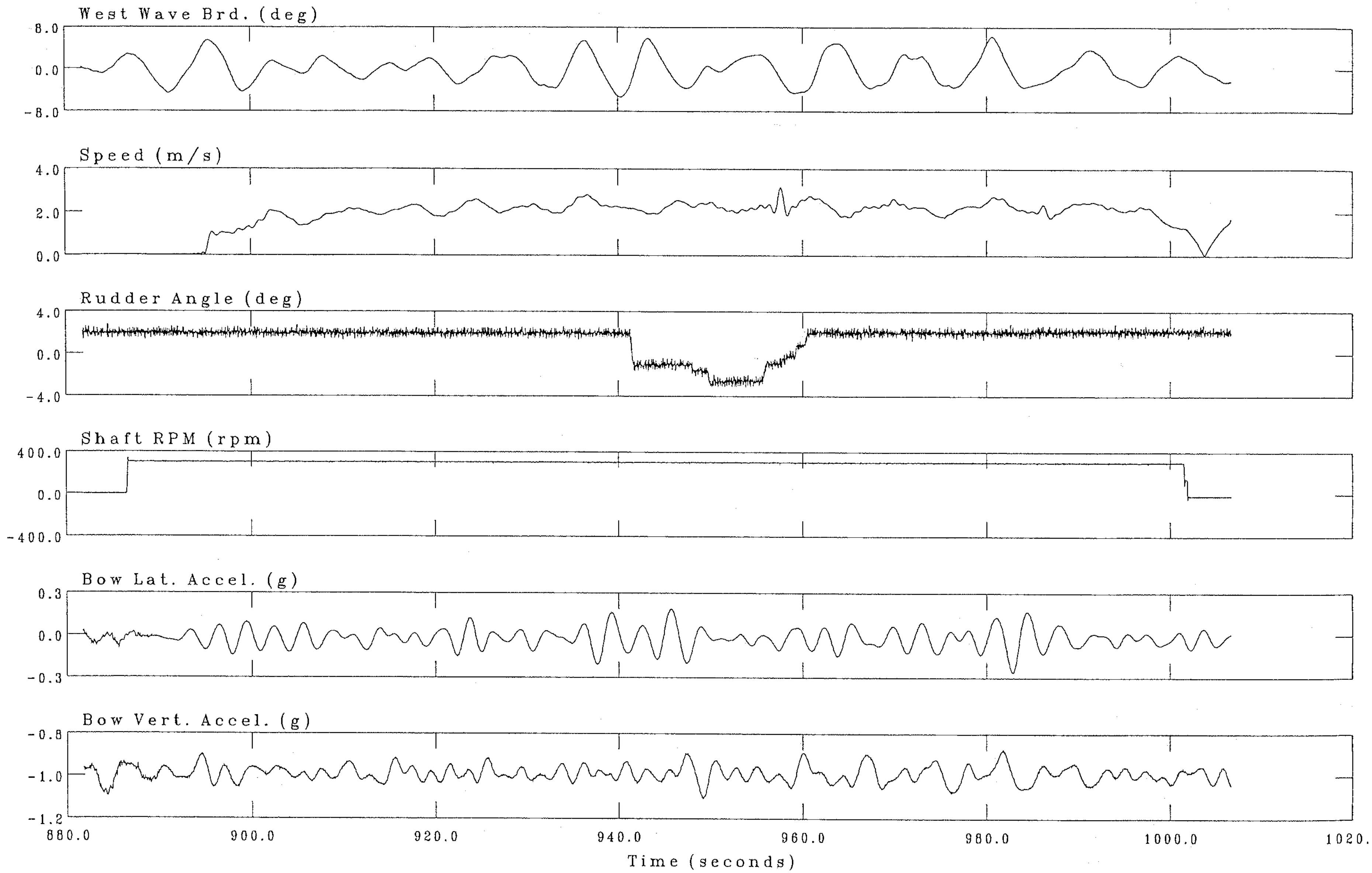

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Figure 4 run_211

Fishing Vessel Safety
CCGA Atlantic Swell Seakeeping Tests

IOT

Analyzed: 01-FEB-2005 11:37:58
Acquired: 1-FEB-2005 11:26:52

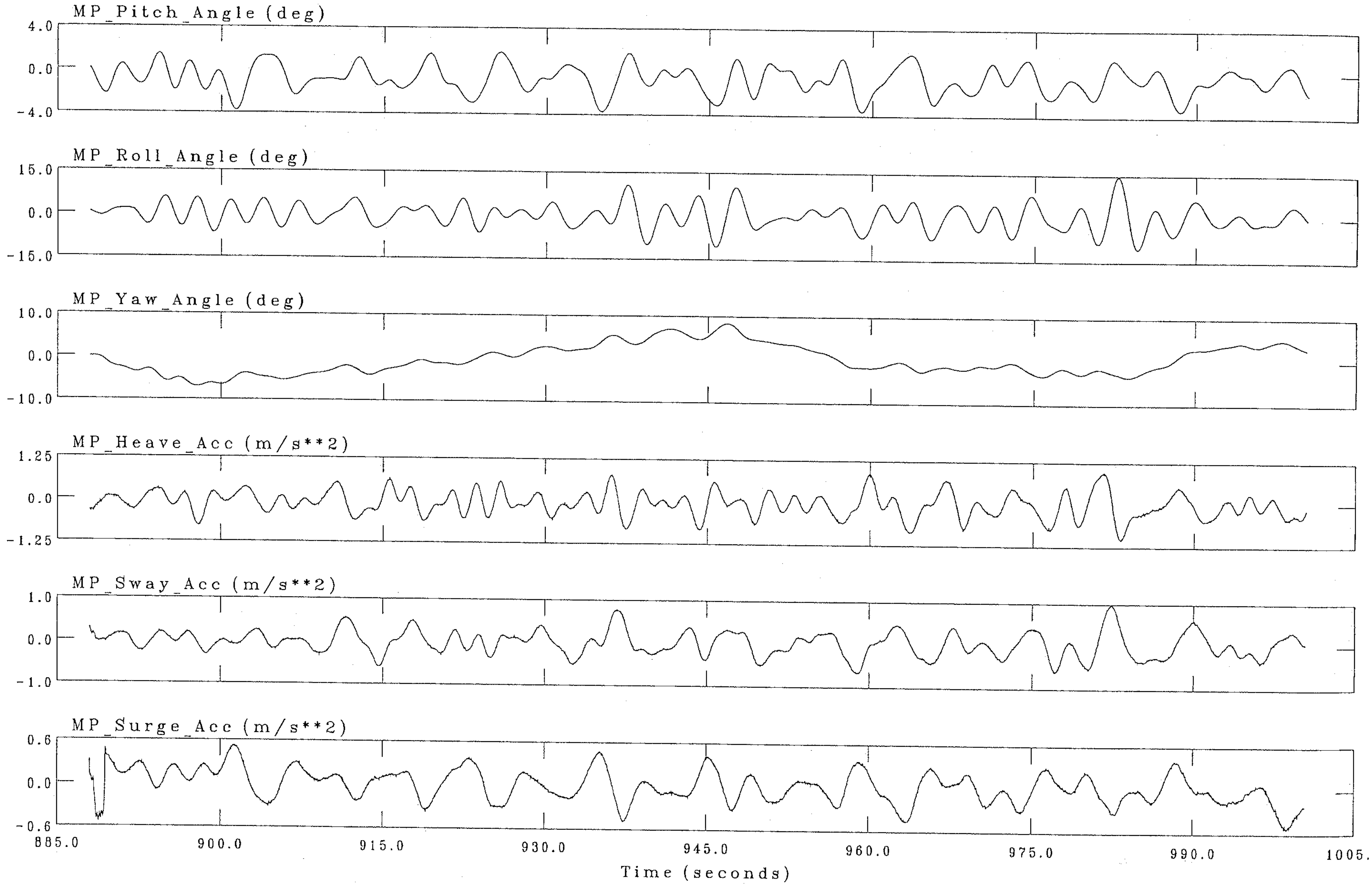

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Figure 5 run_211

--- Z Displ Tare Only ----

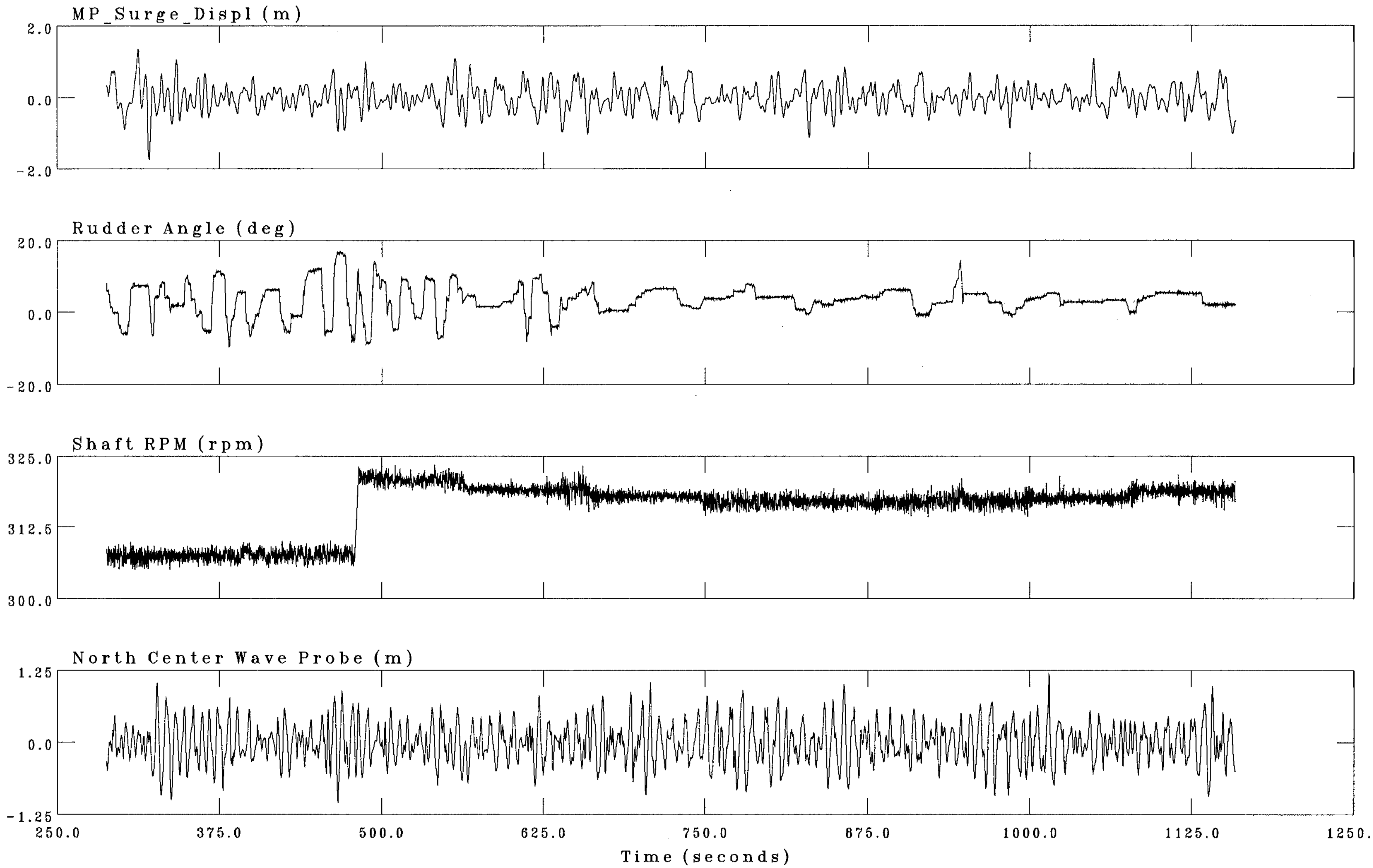
Analysis Date/Time = 1-FEB-2005 11:38:02
Acquired Date/Time = 1-FEB-2005 11:26:52
Input File = CH_S1
Output File = RUN_211_STAT
Number of Samples = 1797
Segment Start Time = 907.80 seconds
Segment End Time = 985.24 seconds

Description	Unit	Min	Max	Mean	S.D.	Chan
South West Wave Probe	m	-1.3393	1.1370	-0.042914	0.49443	1
South Center Wave Probe	m	-0.84032	0.73228	0.0059517	0.27642	2
South East Wave Probe	m	-0.91915	0.78223	-0.0021293	0.29290	3
North Center Wave Probe	m	-0.90206	0.97639	0.019374	0.37319	4
MP Roll Rate	deg/s	-22.484	19.649	-0.030234	7.2004	5
MP Pitch Rate	deg/s	-4.2919	4.2205	0.10647	1.6070	6
MP Yaw Rate	deg/s	-2.2431	2.4117	0.15223	0.94881	7
MP Surge Accel.	g	-0.028743	-0.00053469	-0.011635	0.0052903	8
MP Sway Accel.	g	-0.20225	0.17690	0.00072100	0.063590	9
MP Heave Accel.	g	-1.0930	-0.89711	-1.0044	0.038359	10
Bow Vert. Accel.	g	-1.1044	-0.87389	-0.98934	0.039131	11
Bow Lat. Accel.	g	-0.26334	0.18696	-0.020849	0.074556	12
Shaft RPM	rpm	296.81	306.39	301.29	1.4870	13
Rudder Angle	deg	-3.0709	2.8739	1.1848	1.5471	14
X Displacement	m	-221.20	-51.044	-134.88	49.730	15
Y Displacement	m	59.950	65.191	63.021	1.5189	16
Z Displacement	m	9.8028	11.092	10.510	0.24118	17
Heading Angle	deg	175.07	188.83	180.57	3.4574	18
Pitch Angle	deg	-1.0059	4.6112	2.2345	1.2249	19
Roll Angle	deg	-9.9456	15.473	0.55031	4.3527	20
RMS Error (QUAL)	mm	-20.673	104.20	-12.617	8.4833	21
South Wave Brd.	deg	-8.2869	8.3724	-0.0080286	3.8859	22
X_Disp_CG	m	-221.20	-51.044	-134.88	49.730	23
Y_Disp_CG	m	59.950	65.191	63.021	1.5189	24
Z_Disp_CG	m	9.8028	11.092	10.510	0.24118	25
MP_Surge_Displ	m	-0.73498	0.95364	0.0044212	0.37413	26
MP_Surge_Acc	m/s**2	-0.48231	0.47511	0.00050707	0.19019	27
MP_Surge_Vel	m/s	-0.49091	0.58038	0.014158	0.21530	28
MP_Sway_Displ	m	-0.96743	0.69606	-0.011462	0.35498	29
MP_Sway_Acc	m/s**2	-0.66578	0.99720	0.0044712	0.30338	30
MP_Sway_Vel	m/s	-0.73741	0.77074	0.0073934	0.30630	31
MP_Heave_Displ	m	-0.86686	0.84280	0.0055921	0.32101	32
MP_Heave_Acc	m/s**2	-1.0222	0.96538	-0.056859	0.37690	33
MP_Heave_Vel	m/s	-0.60881	1.0536	0.0074603	0.29518	34
MP_Yaw_Angle	deg	-4.2578	8.3920	0.45871	3.2243	35
MP_Yaw_Acc	deg/sec**2	-5.3229	3.3959	0.0072956	1.3672	36
MP_Yaw_Vel	deg/sec	-2.2423	2.4110	0.15201	0.94870	37
MP_Pitch_Angle	deg	-3.7210	1.7231	-0.68304	1.2246	38
MP_Pitch_Acc	deg/sec**2	-8.7053	9.0763	-0.000045526	2.8799	39
MP_Pitch_Vel	deg/sec	-4.2882	4.2183	0.10618	1.6070	40
MP_Roll_Angle	deg	-10.642	14.743	-0.076747	4.3575	41
MP_Roll_Acc	deg/sec**2	-38.943	34.640	0.26428	13.351	42
MP_Roll_Vel	deg/sec	-22.487	19.653	-0.031577	7.1984	43
Speed	m/s	1.7484	3.1519	2.2205	0.23887	44
Speed	knots	3.3985	6.1267	4.3162	0.46431	45
West Wave Brd.	deg	-5.2919	6.2350	0.015069	2.6528	46

APPENDIX H: EXAMPLE TIME SERIES PLOTS

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 12-APR-2005 15:44:10
Acquired: 13-JAN-2005 11:35



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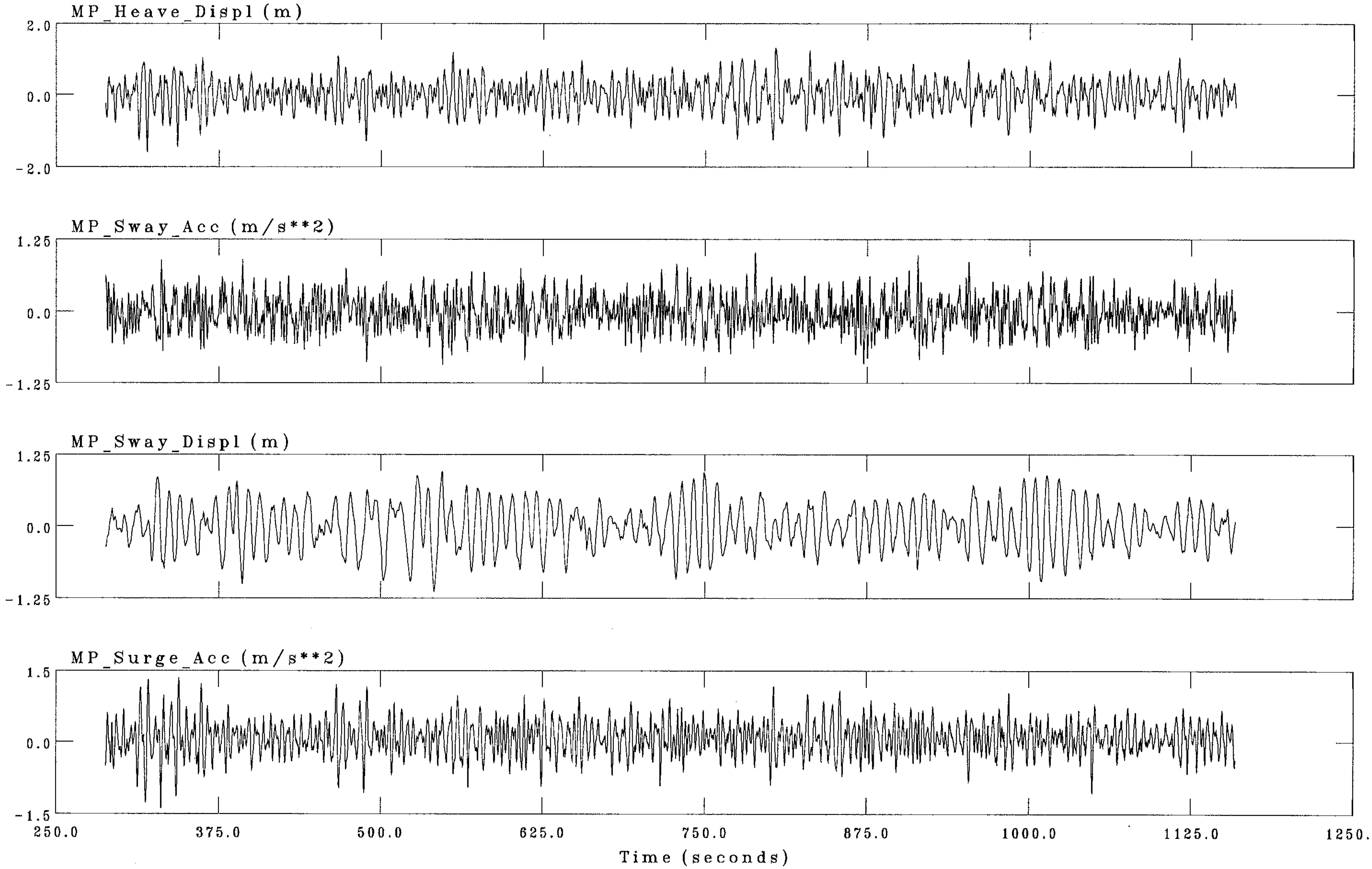
GENERATED BY: 4 | CHECKED BY: | APPROVED BY:

Figure 1 SEQ_1_SPD4_HDG205

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 12-APR-2005 15:44:10
Acquired: 13-JAN-2005 11:35



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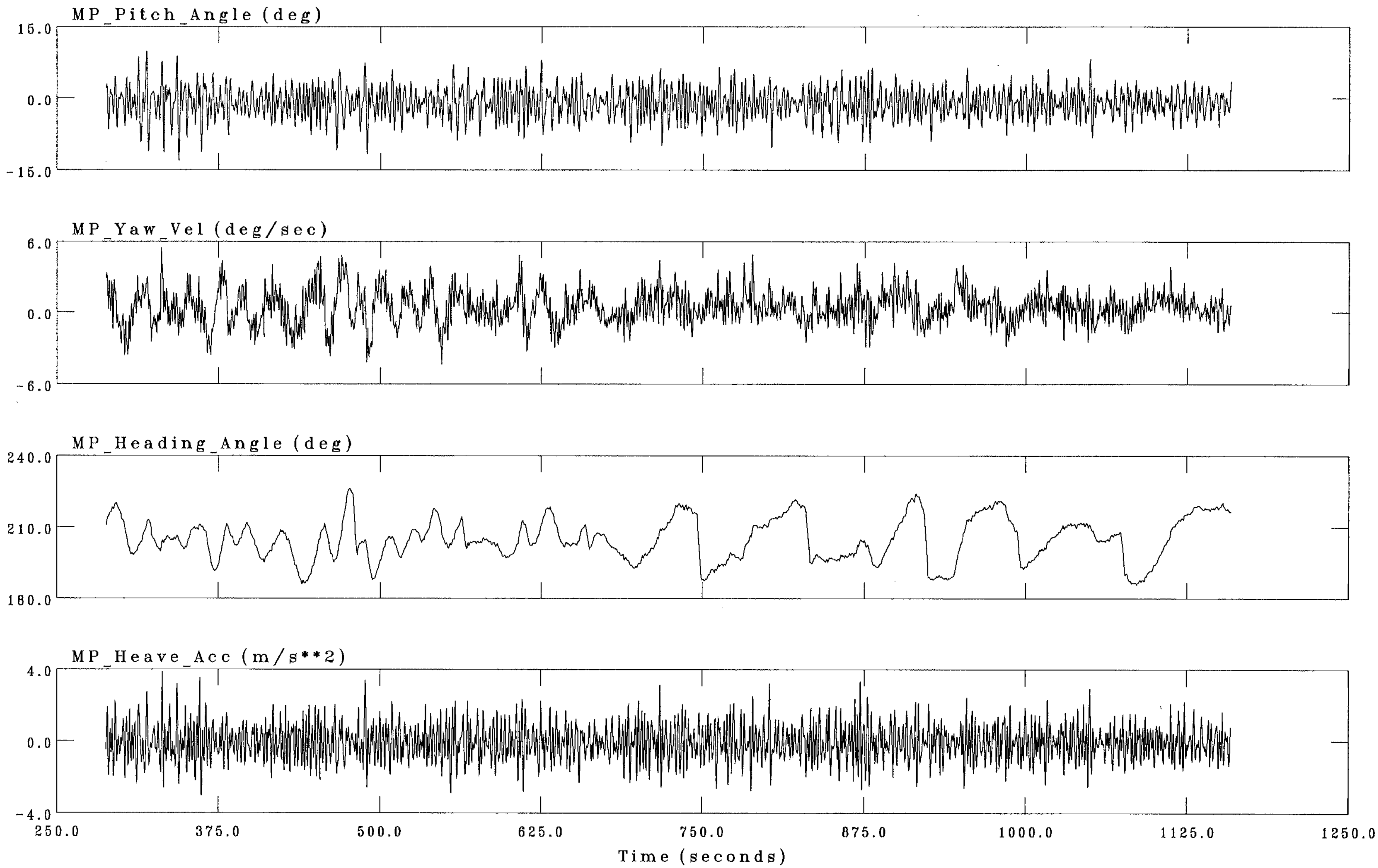
GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 2 SEQ_1_SPD4_HDG205

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 12-APR-2005 15:44:10
Acquired: 13-JAN-2005 11:35

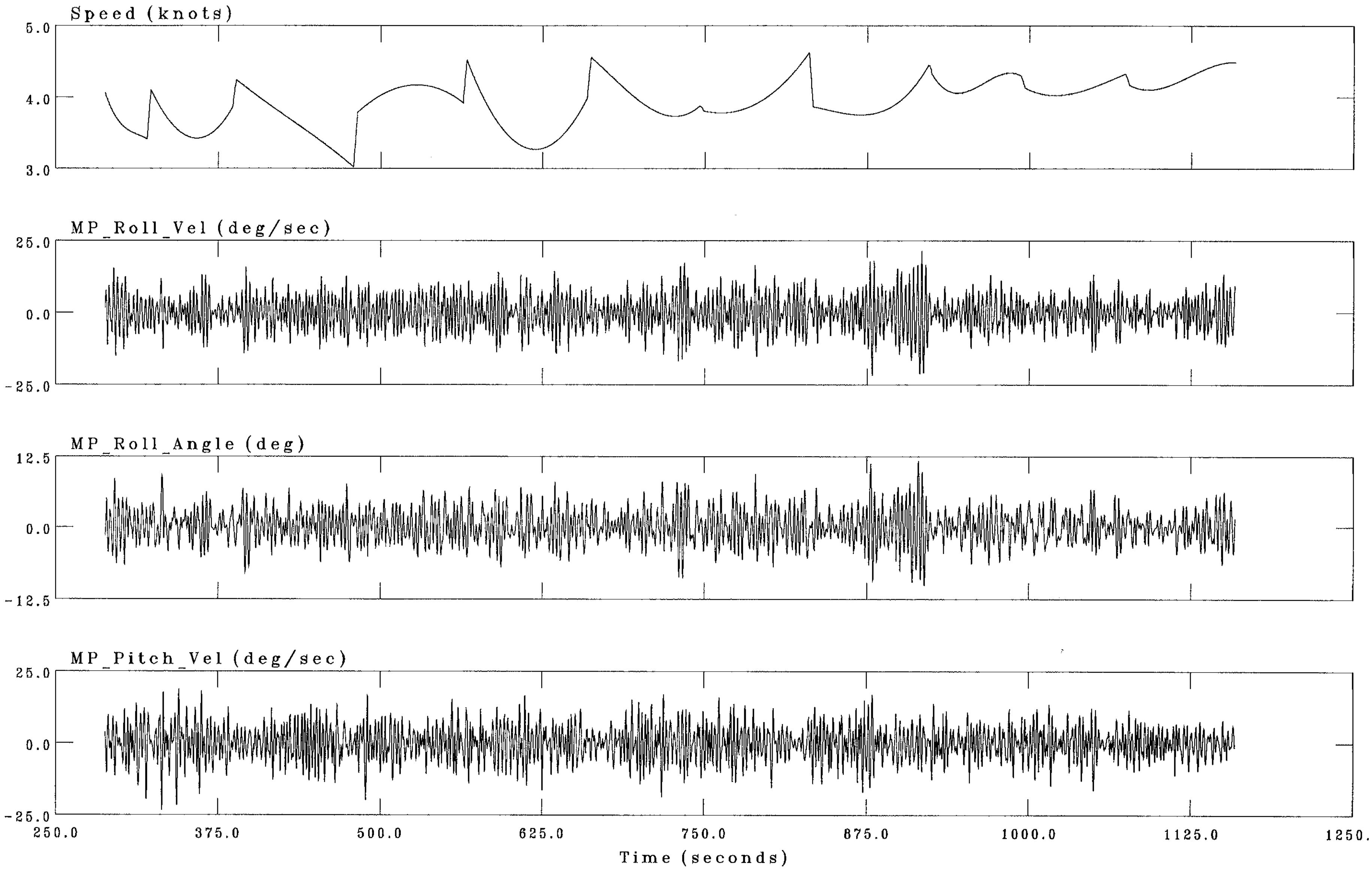


National Research Council Canada Institute for Ocean Technology	GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 3 SEQ_1_SPD4_HDG205

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 12-APR-2005 15:44:10
Acquired: 13-JAN-2005 11:35



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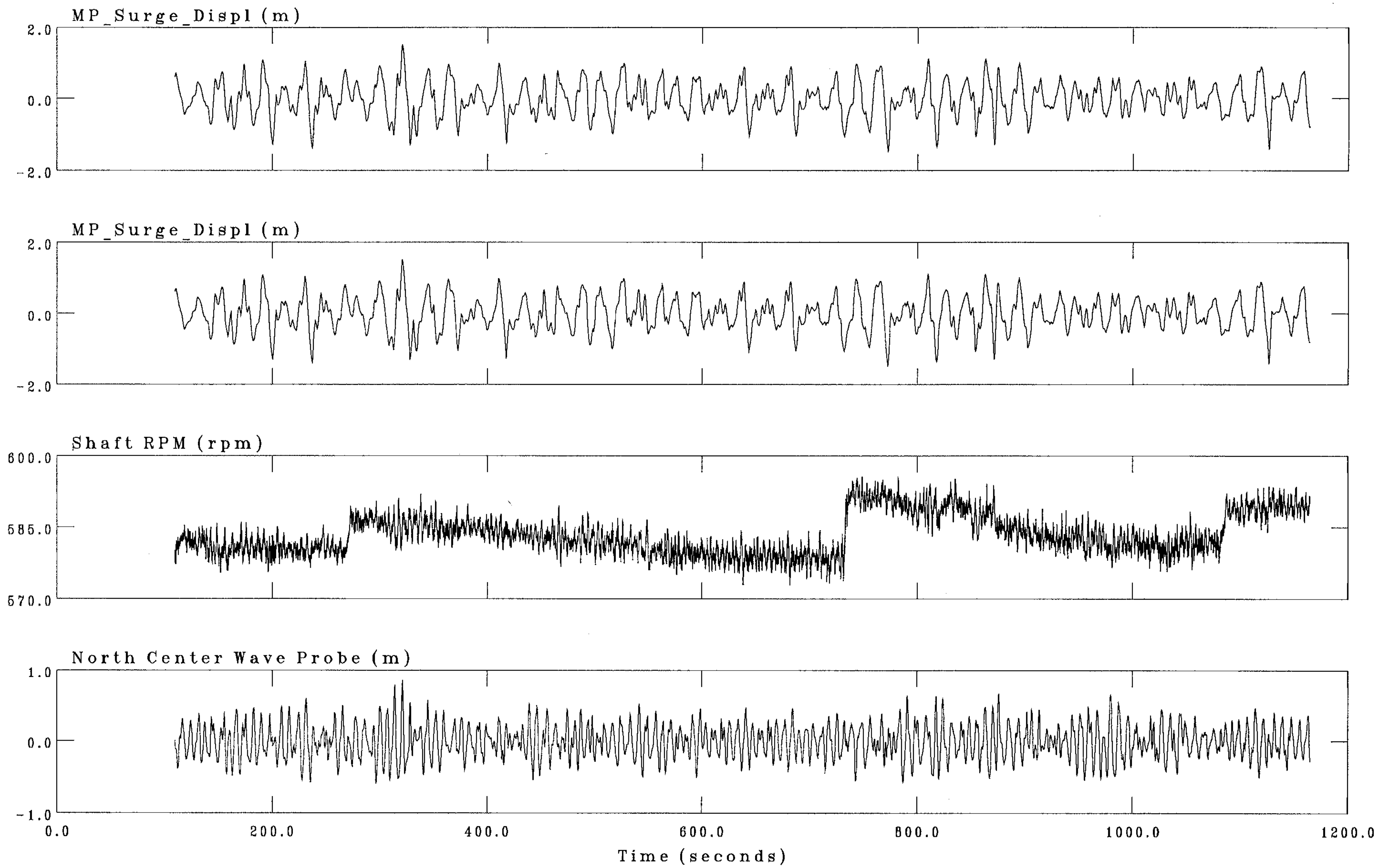
GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 4 SEQ_1_SPD4_HDG205

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 15-APR-2005 11:28:13
Acquired: 17-JAN-2005 14:12



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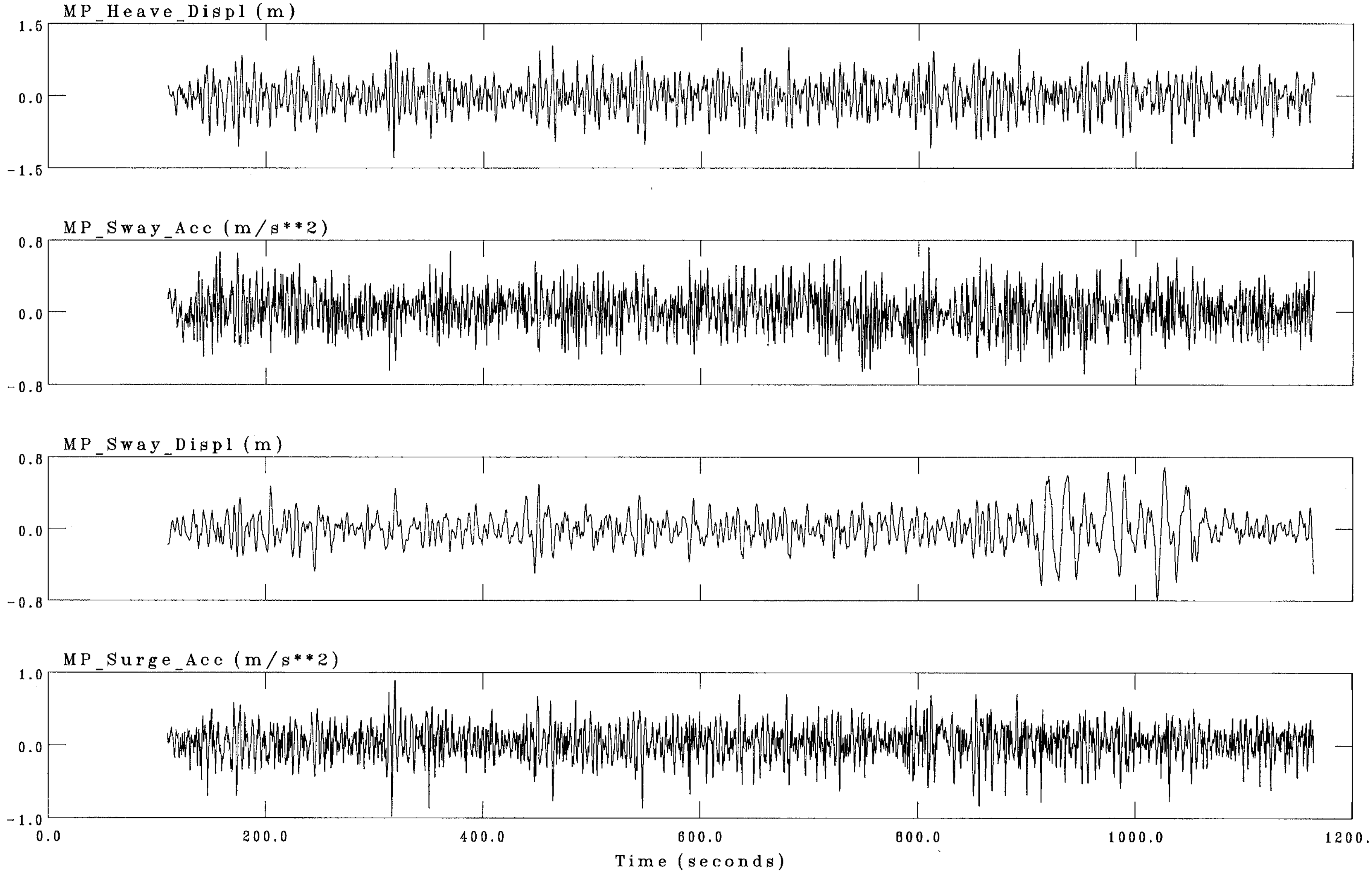
GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 1 SEQ_4_SPD8_HDG210

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 15-APR-2005 11:28:13
Acquired: 17-JAN-2005 14:12



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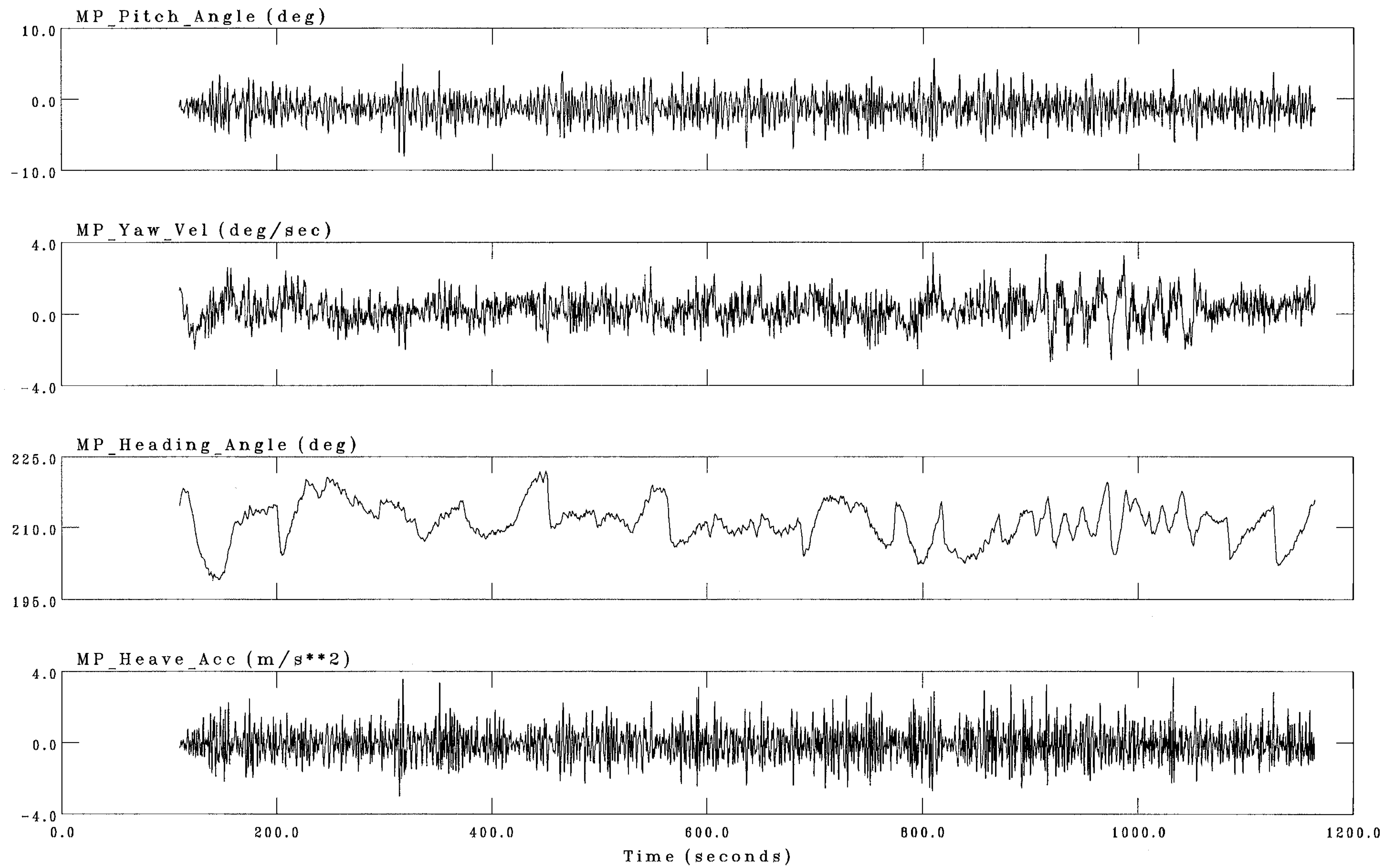
GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 2 SEQ_4_SPD8_HDG210

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 15-APR-2005 11:28:13
Acquired: 17-JAN-2005 14:12



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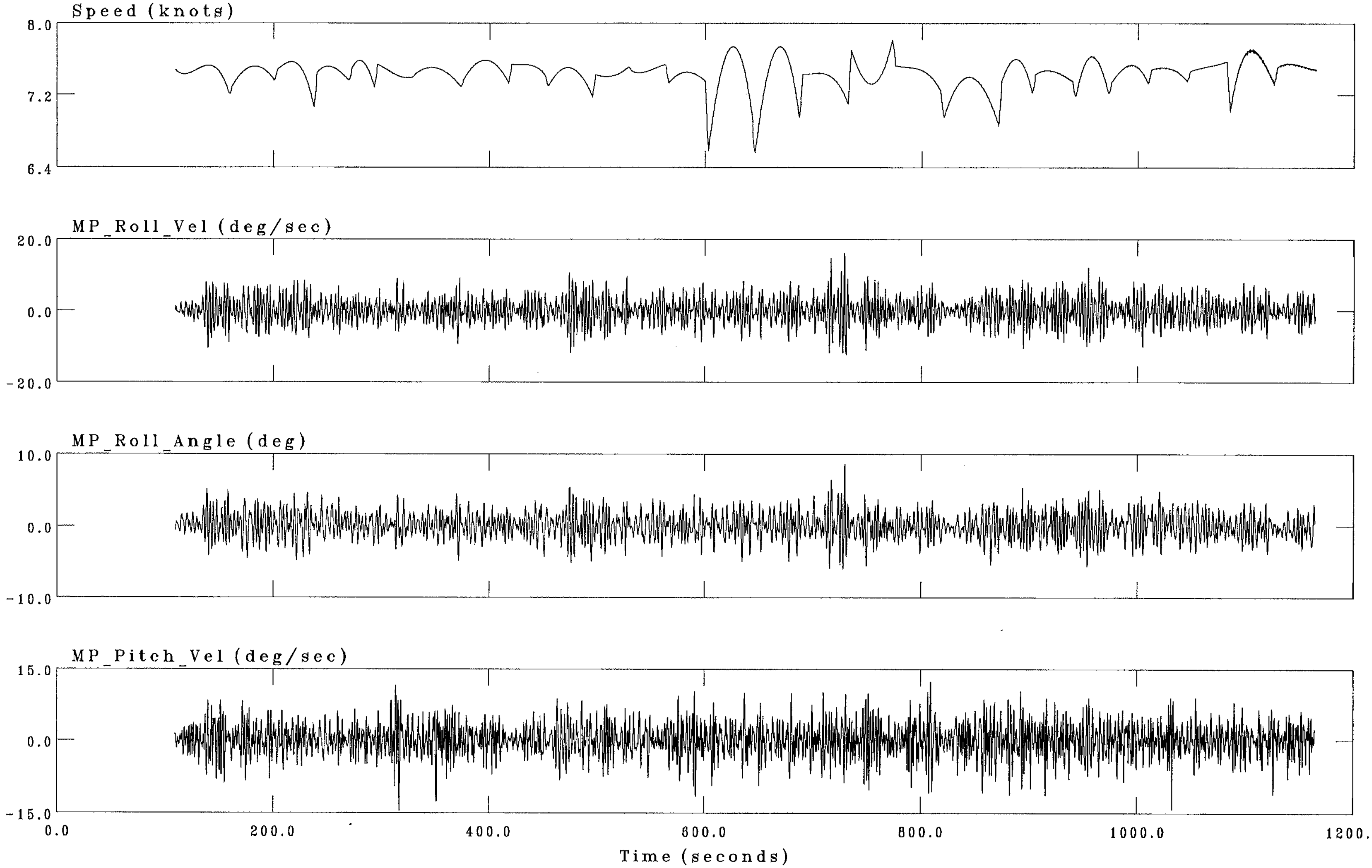
GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 3 SEQ_4_SPD8_HDG210

FISHING VESSEL SAFETY PROJECT
CCGA ATLANTIC SWELL SEAKEEPING TESTS IOT

Analyzed: 15-APR-2005 11:28:13
Acquired: 17-JAN-2005 14:12



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GENERATED BY: 4	CHECKED BY:	APPROVED BY:

Figure 4 SEQ_4_SPD8_HDG210

APPENDIX I: BASIC STATISTICS FOR MERGED SEAKEEPING RUNS

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 0 knots full scale (beam sea drift run)
Heading with respect to incident wave = 270 degrees
MUN WAVE 2 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/21/2005 14:32		
Acquired Date/Time	=	2/2/2005 10:44		
Input File	=	SPD0_HDG270A		
Output File	=	SPD0_HDG270A_STAT		
Number of Samples	=	25080		
Segment Start Time	=	114.99 seconds		
Segment End Time	=	1202.0 seconds		
Segment Total Time	=	1087 seconds	=	18.1 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.98631	0.96645	-0.000997	0.31443	0.62886	1
Shaft RPM	RPM	N/A	N/A	N/A	N/A	N/A	2
Rudder Angle	deg	N/A	N/A	N/A	N/A	N/A	3
MP_Surge_Displ	m	-1.1433	0.9931	-0.00024	0.28439	0.56878	4
MP_Surge_Acc	m/s^2	-0.81257	0.9656	0.001197	0.21503	0.43006	5
MP_Sway_Displ	m	-1.0965	0.98922	0.000279	0.32783	0.65566	6
MP_Sway_Acc	m/s^2	-0.94682	1.0024	-0.003445	0.30381	0.60762	7
MP_Heave_Displ	m	-1.5802	1.0973	-0.0003	0.35255	0.7051	8
MP_Heave_Acc	m/s^2	-1.5723	2.0489	-0.05459	0.41982	0.83964	9
MP_Heading_Angle	deg	213.63	305.68	264.82	23	46	10
MP_Yaw_Vel	deg/s	-3.525	4.3259	0.14704	0.97757	1.95514	11
MP_Pitch_Angle	deg	-6.8776	6.2416	-0.57044	1.8719	3.7438	12
MP_Pitch_Vel	deg/s	-11.274	10.892	0.1506	3.1367	6.2734	13
MP_Roll_Angle	deg	-17.339	18.131	0.20338	4.9382	9.8764	14
MP_Roll_Vel	deg/s	-29.032	27.97	0.013218	9.1295	18.259	15
Speed	knots	N/A	N/A	N/A	N/A	N/A	16

MP_Heave_Acc	m/s^2	ZCA_NWU	328
		ZCA_NWD	329
North Center Wave Probe	m	WAV_HM0	1.25774
	s	SPEC_TPD	7.21039

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Statistics computed using Run 220 & 221.
Model was positioned port side facing the incident waves (Heading Angle = 270 deg.)

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 0 knots full scale (beam sea drift run)
Heading with respect to incident wave = 270 degrees
MUN WAVE 2 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/29/2005 12:29		
Acquired Date/Time	=	2/14/2005 11:56		
Input File	=	SPD0_HDG270B		
Output File	=	SPD0_HDG270B_STAT		
Number of Samples	=	25379		
Segment Start Time	=	119.98 seconds		
Segment End Time	=	1220.0 seconds		
Segment Total Time	=	1100.1 seconds	=	18.3 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.95095	1.0114	-0.0020766	0.31513	0.63026	1
Shaft RPM	RPM	N/A	N/A	N/A	N/A	N/A	2
Rudder Angle	deg	N/A	N/A	N/A	N/A	N/A	3
MP_Surge_Displ	m	-1.0235	1.0208	-0.00035801	0.32789	0.65578	4
MP_Surge_Acc	m/s^2	-0.9229	0.94558	0.00064415	0.23176	0.46352	5
MP_Sway_Displ	m	-1.0969	1.0737	0.00012445	0.29831	0.59662	6
MP_Sway_Acc	m/s^2	-1.0106	1.1771	-0.0026028	0.29758	0.59516	7
MP_Heave_Displ	m	-1.088	1.0364	0.00028101	0.35816	0.71632	8
MP_Heave_Acc	m/s^2	-1.52	1.6263	-0.054013	0.43928	0.87856	9
MP_Heading_Angle	deg	234.65	293.57	267.17	14.552	29.104	10
MP_Yaw_Vel	deg/s	-2.9284	3.9172	0.21409	0.89826	1.79652	11
MP_Pitch_Angle	deg	-8.7764	7.1366	-0.45752	1.8619	3.7238	12
MP_Pitch_Vel	deg/s	-12.396	12.991	0.1448	3.168	6.336	13
MP_Roll_Angle	deg	-14.949	16.254	0.14411	5.2282	10.4564	14
MP_Roll_Vel	deg/s	-30.172	28.658	0.011272	9.6725	19.345	15
Speed	knots	N/A	N/A	N/A	N/A	N/A	16

MP_Heave_Acc	m/s^2		ZCA_NWU	342
			ZCA_NWD	343
North Center Wave Probe		m	WAV_HM0	1.26051
		s	SPEC_TPD	7.00159

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Statistics computed using Run 331 & 332.
Model was positioned port side facing the incident waves (Heading Angle = 270 deg.)

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 0 knots full scale (beam sea drift run)
Heading with respect to incident wave = 270 degrees
IOT WAVE 2 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/29/2005 15:27		
Acquired Date/Time	=	2/14/2005 12:31		
Input File	=	IOT0_HDG270		
Output File	=	IOT0_HDG270_STAT		
Number of Samples	=	24387		
Segment Start Time	=	119.98 seconds		
Segment End Time	=	1177.0 seconds		
Segment Total Time	=	1057.02 seconds	=	17.62 minutes

Description	Unit	Min	Max	Mean	Std. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.83288	0.93837	-0.003102	0.29586	0.59172	1
Shaft RPM	RPM	-3.8145	2.2555	-0.67939	0.88366	1.76732	2
Rudder Angle	deg	-0.62744	0.79866	0.1506	0.26695	0.5339	3
MP_Surge_Displ	m	-0.70702	0.69471	0.000827	0.1996	0.3992	4
MP_Surge_Acc	m/s^2	-0.66412	0.77291	-0.000241	0.21614	0.43228	5
MP_Sway_Displ	m	-0.97399	1.0412	-0.00192	0.36119	0.72238	6
MP_Sway_Acc	m/s^2	-1.0866	0.98636	-0.003697	0.32969	0.65938	7
MP_Heave_Displ	m	-1.2199	1.2477	0.000211	0.36338	0.72676	8
MP_Heave_Acc	m/s^2	-1.7388	1.6184	-0.055144	0.4652	0.9304	9
MP_Heading_Angle	deg	238.02	298.54	267.81	12.774	25.548	10
MP_Yaw_Vel	deg/s	-3.2569	4.4083	0.24146	1.0241	2.0482	11
MP_Pitch_Angle	deg	-8.2033	5.6056	-0.45446	1.9041	3.8082	12
MP_Pitch_Vel	deg/s	-13.762	12.341	0.15097	3.4621	6.9242	13
MP_Roll_Angle	deg	-15.608	19.487	0.1647	5.4505	10.901	14
MP_Roll_Vel	deg/s	-30.718	32.302	0.018977	10.026	20.052	15
Speed	knots	0.1259	0.48373	0.37446	0.099386	0.198772	16

MP_Heave_Acc	m/s^2	ZCA_NWU	316
		ZCA_NWD	317
North Center Wave Probe	m	WAV_HM0	1.18343
	s	SPEC_TPD	7.45102

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Statistics computed using Runs 333 to 335.
Model was positioned port side facing the incident waves (Heading Angle = 270 deg.)

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 4 knots full scale
Heading with respect to incident wave = 155 degrees (205 degrees)
Run Sequence #1 MUN WAVE 1F **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	2/18/2005 11:39		
Acquired Date/Time	=	1/13/2005 15:26		
Input File	=	SPD4_HDG205		
Output File	=	SPD4_HDG205_STAT		
Number of Samples	=	20111		
Segment Start Time	=	287.59 seconds		
Segment End Time	=	1159.2 seconds		
Segment Total Time	=	871.6 seconds	=	14.5 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-1.0212	1.1802	-0.00985	0.33992	0.67984	1
Shaft RPM	RPM	305.06	323.45	315.82	4.6259	9.2518	2
Rudder Angle	deg	-9.5387	16.782	3.3307	4.024	8.048	3
MP_Surge_Displ	m	-1.71	1.3504	0.001928	0.35833	0.71666	4
MP_Surge_Acc	m/s^2	-1.3807	1.3479	0.077987	0.34393	0.68786	5
MP_Sway_Displ	m	-1.1312	0.95773	-0.00244	0.38211	0.76422	6
MP_Sway_Acc	m/s^2	-0.92846	1.0254	-0.01671	0.28091	0.56182	7
MP_Heave_Displ	m	-1.5431	1.3029	0.001961	0.40652	0.81304	8
MP_Heave_Acc	m/s^2	-3.0498	3.8575	-0.07378	0.94274	1.88548	9
MP_Heading_Angle	deg	136.06	176.02	155	8.8194	17.6388	10
MP_Yaw_Vel	deg/s	-4.3764	5.4495	0.437	1.371	2.742	11
MP_Pitch_Angle	deg	-12.969	9.8833	-0.96543	2.9577	5.9154	12
MP_Pitch_Vel	deg/s	-23.202	18.812	0.14772	5.6955	11.391	13
MP_Roll_Angle	deg	-10.112	11.73	0.20563	2.8565	5.713	14
MP_Roll_Vel	deg/s	-21.777	21.448	0.026285	5.592	11.184	15
Speed	knots	3.0183	4.6254	3.9304	0.32412	0.64824	16

MP_Heave_Acc	m/s^2	ZCA_NWU	328
		ZCA_NWD	329
North Center Wave Probe	m	WAV_HM0	1.35968
	s	SPEC_TPD	7.90634

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Increased shaft speed from 309 RPM to 318 RPM after third run segment.
High rudder angle amplitudes noted.
First run segment appears to be missing?? Short Run.
High rudder angle amplitudes noted.

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 4 knots full scale
Heading with respect to incident wave = 115 degrees (245 degrees)
Run Sequence #2 MUN WAVE 2F Wave Direction = 65 degrees w.r.t. south wall.

Analysis Date/Time	=	4/12/2005 15:42		
Acquired Date/Time	=	1/14/2005 11:44		
Input File	=	SPD4_HDG245		
Output File	=	SPD4_HDG245_STAT		
Number of Samples	=	27475		
Segment Start Time	=	107.67 seconds		
Segment End Time	=	1298.4 seconds		
Segment Total Time	=	1190.7 seconds	=	19.8 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-1.0417	0.92603	-0.007718	0.35784	0.71568	1
Shaft RPM	RPM	313.64	324.43	318.84	1.8763	3.7526	2
Rudder Angle	deg	-8.3709	11.816	2.6766	2.0671	4.1342	3
MP_Surge_Displ	m	-1.1925	0.93918	-0.009517	0.31459	0.62918	4
MP_Surge_Acc	m/s^2	-0.86603	0.87002	0.071342	0.23962	0.47924	5
MP_Sway_Displ	m	-1.3049	1.2033	-0.001833	0.4054	0.8108	6
MP_Sway_Acc	m/s^2	-1.0891	1.0858	0.010037	0.28539	0.57078	7
MP_Heave_Displ	m	-1.3266	1.2171	-0.00077	0.38873	0.77746	8
MP_Heave_Acc	m/s^2	-2.7105	2.4937	-0.070604	0.78737	1.57474	9
MP_Heading_Angle	deg	98.26	131.99	113.42	6.5478	13.0956	10
MP_Yaw_Vel	deg/s	-3.4395	4.0368	0.27408	0.98578	1.97156	11
MP_Pitch_Angle	deg	-8.5227	7.1108	-0.93064	2.3028	4.6056	12
MP_Pitch_Vel	deg/s	-16.772	17.85	0.15608	4.8533	9.7066	13
MP_Roll_Angle	deg	-9.2226	8.2166	0.39513	2.6	5.2	14
MP_Roll_Vel	deg/s	-16.781	16.917	0.016192	4.4248	8.8496	15
Speed	knots	3.153	4.9582	4.188	0.21515	0.4303	16

MP_Heave_Acc	m/s^2	ZCA_NWU	470
		ZCA_NWD	471
North Center Wave Probe	m	WAV_HM0	1.43137
	s	SPEC_TPD	7.81697

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Noted gradual reduction in shaft RPM from 320 to 316.
One rudder angle amplitude greater than 10 degrees noted.

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 4 knots full scale
Heading with respect to incident wave = -150 degrees (210 degrees)
Run Sequence #3 MUN WAVE 1 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/12/2005 15:41		
Acquired Date/Time	=	1/17/2005 12:31		
Input File	=	SPD4_HDG210		
Output File	=	SPD4_HDG210_STAT		
Number of Samples	=	25118		
Segment Start Time	=	131.08 seconds		
Segment End Time	=	1219.7 seconds		
Segment Total Time	=	1088.6 seconds	=	18.1 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.94076	0.98843	-0.00761	0.33087	0.66174	1
Shaft RPM	RPM	315.45	329.22	323.65	1.9353	3.8706	2
Rudder Angle	deg	-7.2563	16.889	2.6926	2.5241	5.0482	3
MP_Surge_Displ	m	-1.1578	1.0362	0.008695	0.37539	0.75078	4
MP_Surge_Acc	m/s^2	-1.0394	1.2105	0.07176	0.29876	0.59752	5
MP_Sway_Displ	m	-0.74065	0.81257	-0.00215	0.24052	0.48104	6
MP_Sway_Acc	m/s^2	-0.82349	0.79495	0.015989	0.23086	0.46172	7
MP_Heave_Displ	m	-1.3809	1.0929	-0.00106	0.38285	0.7657	8
MP_Heave_Acc	m/s^2	-3.1006	3.3408	-0.0737	0.91683	1.83366	9
MP_Heading_Angle	deg	199.55	226.95	211.33	5.3377	10.6754	10
MP_Yaw_Vel	deg/s	-3.5106	4.3371	0.26518	1.0462	2.0924	11
MP_Pitch_Angle	deg	-10.667	7.9845	-0.91326	2.8654	5.7308	12
MP_Pitch_Vel	deg/s	-23.031	21.335	0.15159	6.1988	12.3976	13
MP_Roll_Angle	deg	-8.1772	8.2635	0.15986	2.4712	4.9424	14
MP_Roll_Vel	deg/s	-15.32	15.934	0.003214	4.2492	8.4984	15
Speed	knots	3.3336	4.8292	3.9479	0.27045	0.5409	16

MP_Heave_Acc	m/s^2	ZCA_NWU	427
		ZCA_NWD	428
North Center Wave Probe	m	WAV_HM0	1.32346
	s	SPEC_TPD	7.53527

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Shaft speed increased from 318 RPM to 325 RPM after second run segment.
Three rudder angle amplitudes greater than 10 degrees noted.

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 8 knots full scale
Heading with respect to incident wave = 150 degrees (210 degrees)
Run Sequence #4 MUN WAVE 3F **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/15/2005 11:28		
Acquired Date/Time	=	1/19/2005 9:18		
Input File	=	SPD8_HDG210		
Output File	=	SPD8_HDG210_STAT		
Number of Samples	=	24372		
Segment Start Time	=	109.27 seconds		
Segment End Time	=	1165.4 seconds		
Segment Total Time	=	1056.13 seconds	=	17.6 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.59189	0.86054	-0.00277	0.23205	0.4641	1
Shaft RPM	RPM	572.92	595.68	583.48	4.1356	8.2712	2
Rudder Angle	deg	-3.0614	5.6819	2.3982	1.0754	2.1508	3
MP_Surge_Displ	m	-1.4856	1.5055	-0.00588	0.46504	0.93008	4
MP_Surge_Acc	m/s^2	-0.97285	0.88862	0.044276	0.21291	0.42582	5
MP_Sway_Displ	m	-0.78826	0.67826	0.000904	0.1735	0.347	6
MP_Sway_Acc	m/s^2	-0.67912	0.71976	0.022018	0.19653	0.39306	7
MP_Heave_Displ	m	-1.2838	1.032	0.001438	0.31675	0.6335	8
MP_Heave_Acc	m/s^2	-2.9949	3.6461	-0.07411	0.83171	1.66342	9
MP_Heading_Angle	deg	139.06	161.82	151.11	4.1922	8.3844	10
MP_Yaw_Vel	deg/s	-2.6739	3.419	0.26712	0.75226	1.50452	11
MP_Pitch_Angle	deg	-8.037	5.702	-1.165	1.6591	3.3182	12
MP_Pitch_Vel	deg/s	-14.536	12.313	0.14795	3.33	6.66	13
MP_Roll_Angle	deg	-5.9882	8.4397	0.1231	1.7518	3.5036	14
MP_Roll_Vel	deg/s	-11.915	16.143	0.020885	3.3754	6.7508	15
Speed	knots	6.5763	7.8097	7.436	0.14718	0.29436	16

MP_Heave_Acc	m/s^2	ZCA_NWU	418
		ZCA_NWD	419
North Center Wave Probe	m	WAV_HM0	0.928213
	s	SPEC_TPD	7.40474

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 8 knots full scale
Heading with respect to incident wave = -160 degrees (200 degrees)
Run Sequence #5 MUN WAVE 3 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/14/2005 16:38		
Acquired Date/Time	=	1/20/2005 14:52		
Input File	=	SPD8_HDG200		
Output File	=	SPD8_HDG200_STAT		
Number of Samples	=	23410		
Segment Start Time	=	109.71 seconds		
Segment End Time	=	1124.2 seconds		
Segment Total Time	=	1056.13 seconds	=	17.6 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.87524	0.80089	-0.000149	0.27782	0.55564	1
Shaft RPM	RPM	570.45	599.19	582.87	5.3655	10.731	2
Rudder Angle	deg	-1.859	6.881	2.2999	1.0045	2.009	3
MP_Surge_Displ	m	-1.3806	1.3133	-0.029473	0.35961	0.71922	4
MP_Surge_Acc	m/s^2	-0.94806	0.66936	0.050839	0.20195	0.4039	5
MP_Sway_Displ	m	-0.64827	0.44077	-0.001087	0.13254	0.26508	6
MP_Sway_Acc	m/s^2	-0.97835	0.89675	-0.008173	0.25197	0.50394	7
MP_Heave_Displ	m	-1.2921	0.96452	-0.002123	0.31388	0.62776	8
MP_Heave_Acc	m/s^2	-2.6507	3.7578	-0.066774	0.78539	1.57078	9
MP_Heading_Angle	deg	186.17	212.11	198.14	4.3895	8.779	10
MP_Yaw_Vel	deg/s	-2.9214	3.8117	0.13881	0.83385	1.6677	11
MP_Pitch_Angle	deg	-6.9579	4.0963	-1.1942	1.5233	3.0466	12
MP_Pitch_Vel	deg/s	-12.113	11.434	0.15019	2.7905	5.581	13
MP_Roll_Angle	deg	-9.6546	10.109	0.15151	2.6423	5.2846	14
MP_Roll_Vel	deg/s	-17.477	18.168	0.025722	5.0711	10.1422	15
Speed	knots	7.0618	8.0903	7.4353	0.11244	0.22488	16

MP_Heave_Acc	m/s^2	ZCA_NWU	394
		ZCA_NWD	395
North Center Wave Probe	m	WAV_HM0	1.11127
	s	SPEC_TPD	7.42725

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 8 knots full scale
Heading with respect to incident wave = -160 degrees (200 degrees)
Run Sequence #5 IOT WAVE 3 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/15/2005 12:01		
Acquired Date/Time	=	1/25/2005 12:19		
Input File	=	SPD8_HDG200		
Output File	=	SPD8_HDG200_STAT		
Number of Samples	=	24488		
Segment Start Time	=	108.10 seconds		
Segment End Time	=	1169.3 seconds		
Segment Total Time	=	1061.2 seconds	=	17.7 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.87211	0.96561	-0.000729	0.2683	0.5366	1
Shaft RPM	RPM	574.5	594.51	584.99	2.7671	5.5342	2
Rudder Angle	deg	-1.5075	6.4932	2.1371	1.0431	2.0862	3
MP_Surge_Displ	m	-1.268	1.1511	-0.025848	0.37036	0.74072	4
MP_Surge_Acc	m/s^2	-0.99622	0.81967	0.053835	0.23142	0.46284	5
MP_Sway_Displ	m	-0.69639	0.71086	0.005796	0.18961	0.37922	6
MP_Sway_Acc	m/s^2	-0.63127	0.72298	0.014174	0.17507	0.35014	7
MP_Heave_Displ	m	-1.1814	0.96511	0.000693	0.33376	0.66752	8
MP_Heave_Acc	m/s^2	-3.9195	3.7328	-0.063661	0.98462	1.96924	9
MP_Heading_Angle	deg	188.61	209.31	198.92	3.1093	6.2186	10
MP_Yaw_Vel	deg/s	-2.7373	3.9601	0.081058	0.72302	1.44604	11
MP_Pitch_Angle	deg	-9.7004	5.6701	-1.1981	1.9101	3.8202	12
MP_Pitch_Vel	deg/s	-16.931	17.274	0.14863	4.2091	8.4182	13
MP_Roll_Angle	deg	-4.4556	5.1461	0.1302	1.3984	2.7968	14
MP_Roll_Vel	deg/s	-8.0506	7.0477	0.030549	2.3456	4.6912	15
Speed	knots	7.0382	7.7042	7.4259	0.089046	0.17809	16

MP_Heave_Acc	m/s^2	ZCA_NWU	458
		ZCA_NWD	459
North Center Wave Probe	m	WAV_HM0	1.07321
	s	SPEC_TPD	7.72956

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 4 knots full scale
Heading with respect to incident wave = 65 degrees
Run Sequence #6 MUN WAVE 2 **Wave Direction = 65 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/12/2005 15:38		
Acquired Date/Time	=	1/28/2005 14:11		
Input File	=	SPD4_HDG65		
Output File	=	SPD4_HDG65_STAT		
Number of Samples	=	24042		
Segment Start Time	=	187.51 seconds		
Segment End Time	=	1229.4 seconds		
Segment Total Time	=	1041.9 seconds	=	17.4 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-1.0876	1.2457	-0.00428	0.31956	0.63912	1
Shaft RPM	RPM	296.53	308.51	302.75	1.7058	3.4116	2
Rudder Angle	deg	-6.9135	8.9572	1.4837	1.7251	3.4502	3
MP_Surge_Displ	m	-1.3271	1.236	-0.00403	0.3719	0.7438	4
MP_Surge_Acc	m/s^2	-0.8133	0.82697	0.036145	0.21374	0.42748	5
MP_Sway_Displ	m	-1.215	1.1678	0.002927	0.30807	0.61614	6
MP_Sway_Acc	m/s^2	-1.1042	1.2834	0.027401	0.31781	0.63562	7
MP_Heave_Displ	m	-1.1312	1.1548	0.001161	0.35729	0.71458	8
MP_Heave_Acc	m/s^2	-1.7285	1.8221	-0.0667	0.43621	0.87242	9
MP_Heading_Angle	deg	55.553	75.875	65.217	3.2007	6.4014	10
MP_Yaw_Vel	deg/s	-3.2865	4.6224	0.30241	1.0998	2.1996	11
MP_Pitch_Angle	deg	-5.9423	3.8991	-0.88506	1.4318	2.8636	12
MP_Pitch_Vel	deg/s	-6.5195	7.0822	0.12909	2.0358	4.0716	13
MP_Roll_Angle	deg	-20.379	20.611	0.054173	5.9818	11.9636	14
MP_Roll_Vel	deg/s	-37.386	36.682	0.050793	10.717	21.434	15
Speed	knots	3.6333	4.5545	4.1895	0.13553	0.27106	16

MP_Heave_Acc	m/s^2	ZCA_NWU	291
		ZCA_NWD	292
North Center Wave Probe	m	WAV_HM0	1.27824
	s	SPEC_TPD	7.12568

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 4 knots full scale
Heading with respect to incident wave = 65 degrees
Run Sequence #6 IOT WAVE 2 **Wave Direction = 65 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/15/2005 12:00		
Acquired Date/Time	=	2/2/2005 10:04		
Input File	=	SPD4_HDG65		
Output File	=	SPD4_HDG65_STAT		
Number of Samples	=	25653		
Segment Start Time	=	115.21 seconds		
Segment End Time	=	1227.0 seconds		
Segment Total Time	=	1111.8 seconds	=	18.5 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-1.0648	1.0251	0.005347	0.33737	0.67474	1
Shaft RPM	RPM	295.64	305.34	300.92	1.3059	2.6118	2
Rudder Angle	deg	-6.7824	8.885	1.5598	1.7551	3.5102	3
MP_Surge_Displ	m	-0.99987	1.1547	-0.00122	0.30748	0.61496	4
MP_Surge_Acc	m/s^2	-0.69668	0.67859	0.031082	0.20704	0.41408	5
MP_Sway_Displ	m	-1.1031	1.3819	0.00218	0.39724	0.79448	6
MP_Sway_Acc	m/s^2	-1.0739	1.0654	0.005685	0.28992	0.57984	7
MP_Heave_Displ	m	-1.0719	1.0642	0.00066	0.34467	0.68934	8
MP_Heave_Acc	m/s^2	-1.5973	1.3829	-0.05532	0.3748	0.7496	9
MP_Heading_Angle	deg	51.807	76.185	65.402	4.0316	8.0632	10
MP_Yaw_Vel	deg/s	-3.9048	4.4859	0.21424	1.0982	2.1964	11
MP_Pitch_Angle	deg	-5.4483	3.9636	-0.84375	1.3631	2.7262	12
MP_Pitch_Vel	deg/s	-7.1637	7.107	0.10604	1.8855	3.771	13
MP_Roll_Angle	deg	-13.058	12.955	-0.02969	4.2191	8.4382	14
MP_Roll_Vel	deg/s	-22.545	20.092	0.060435	7.1067	14.2134	15
Speed	knots	3.4169	4.4976	4.2554	0.14855	0.2971	16

MP_Heave_Acc	m/s^2	ZCA_NWU	353
		ZCA_NWD	354
North Center Wave Probe	m	WAV_HM0	1.34947
	s	SPEC_TPD	7.46056

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 4 knots full scale
Heading with respect to incident wave = 25 degrees
Run Sequence #7 MUN WAVE 1 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/12/2005 15:34		
Acquired Date/Time	=	1/31/2005 14:51		
Input File	=	SPD4_HDG25		
Output File	=	SPD4_HDG25_STAT		
Number of Samples	=	24750		
Segment Start Time	=	118.38 seconds		
Segment End Time	=	1191.0 seconds		
Segment Total Time	=	1072.6 seconds	=	17.9 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.9465	1.0091	-0.00296	0.3365	0.673	1
Shaft RPM	RPM	288.01	298.45	292.83	1.5889	3.1778	2
Rudder Angle	deg	-20.642	17.36	1.9353	2.1861	4.3722	3
MP_Surge_Displ	m	-1.6989	1.6213	-0.00378	0.57295	1.1459	4
MP_Surge_Acc	m/s^2	-0.87415	1.1976	0.041372	0.29099	0.58198	5
MP_Sway_Displ	m	-0.74482	0.76691	0.002978	0.25501	0.51002	6
MP_Sway_Acc	m/s^2	-0.5502	0.49636	0.007577	0.16258	0.32516	7
MP_Heave_Displ	m	-1.1064	0.98808	0.001425	0.32921	0.65842	8
MP_Heave_Acc	m/s^2	-0.71411	0.59188	-0.05531	0.19997	0.39994	9
MP_Heading_Angle	deg	12.248	38.075	24.382	3.7845	7.569	10
MP_Yaw_Vel	deg/s	-4.1756	4.5688	0.12267	1.0449	2.0898	11
MP_Pitch_Angle	deg	-8.1816	5.0769	-0.92557	1.8052	3.6104	12
MP_Pitch_Vel	deg/s	-5.2163	5.378	0.10105	1.6955	3.391	13
MP_Roll_Angle	deg	-4.7143	5.8121	0.24669	1.7111	3.4222	14
MP_Roll_Vel	deg/s	-6.5535	6.2812	0.065731	2.0236	4.0472	15
Speed	knots	3.7886	4.588	4.2685	0.11109	0.22218	16

MP_Heave_Acc	m/s^2	ZCA_NWU	252
		ZCA_NWD	253
North Center Wave Probe	m	WAV_HM0	1.34599
	s	SPEC_TPD	7.61979

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Three rudder angle amplitudes greater than 10 degrees noted.

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 8 knots full scale
Heading with respect to incident wave = 60 degrees
Run Sequence #8 MUN WAVE 3 **Wave Direction = 65 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/18/2005 11:17		
Acquired Date/Time	=	2/11/2005 9:49		
Input File	=	SPD8_HDG60		
Output File	=	SPD8_HDG60_STAT		
Number of Samples	=	25749		
Segment Start Time	=	108.28 seconds		
Segment End Time	=	1224.1 seconds		
Segment Total Time	=	1115.82 seconds	=	19.0 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-1.0541	1.0093	-0.00586	0.33061	0.66122	1
Shaft RPM	RPM	572.27	592.55	585.17	3.738	7.476	2
Rudder Angle	deg	-4.1635	5.0366	1.5978	1.275	2.55	3
MP_Surge_Displ	m	-1.5116	1.3446	-0.03846	0.51532	1.03064	4
MP_Surge_Acc	m/s^2	-0.5444	0.51483	0.070298	0.14271	0.28542	5
MP_Sway_Displ	m	-1.1416	1.5301	0.010744	0.40375	0.8075	6
MP_Sway_Acc	m/s^2	-1.0498	1.0403	0.018391	0.27603	0.55206	7
MP_Heave_Displ	m	-1.1905	1.0261	-0.00189	0.30641	0.61282	8
MP_Heave_Acc	m/s^2	-2.009	2.295	-0.05458	0.5792	1.1584	9
MP_Heading_Angle	deg	49.565	69.527	59.298	3.1725	6.345	10
MP_Yaw_Vel	deg/s	-3.5468	4.4792	0.086929	1.1733	2.3466	11
MP_Pitch_Angle	deg	-5.2598	2.0862	-1.369	1.0233	2.0466	12
MP_Pitch_Vel	deg/s	-7.295	7.5953	0.11355	1.8949	3.7898	13
MP_Roll_Angle	deg	-13.491	8.5629	-0.08874	2.9087	5.8174	14
MP_Roll_Vel	deg/s	-16.645	20.29	0.027615	4.5345	9.069	15
Speed	knots	6.7226	9.5724	7.4773	0.19876	0.39752	16

MP_Heave_Acc	m/s^2	ZCA_NWU	493
		ZCA_NWD	494
North Center Wave Probe	m	WAV_HM0	1.32243
	s	SPEC_TPD	7.447

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Two forward speed spikes greater than 8.5 knots noted.

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 8 knots full scale
Heading with respect to incident wave = 20 degrees
Run Sequence #9 MUN WAVE 3 **Wave Direction = 25 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/18/2005 11:19		
Acquired Date/Time	=	2/14/2005 11:21		
Input File	=	SPD8_HDG20		
Output File	=	SPD8_HDG20_STAT		
Number of Samples	=	22728		
Segment Start Time	=	111.44 seconds		
Segment End Time	=	1096.3 seconds		
Segment Total Time	=	984.86 seconds	=	16.4 minutes

Description	Unit	Min	Max	Mean	St. Dev.	Sig.	Chan
North Center Wave Probe	m	-0.89839	0.79604	-0.003533	0.281	0.562	1
Shaft RPM	RPM	574.98	592.43	585.4	2.6196	5.2392	2
Rudder Angle	deg	-2.6291	5.3408	1.7305	1.3026	2.6052	3
MP_Surge_Displ	m	-1.8719	2.1461	0.001278	0.6303	1.2606	4
MP_Surge_Acc	m/s^2	-0.55879	0.79677	0.074154	0.2063	0.4126	5
MP_Sway_Displ	m	-1.1477	0.95092	-0.003668	0.28706	0.57412	6
MP_Sway_Acc	m/s^2	-0.66446	0.63611	-0.011899	0.20088	0.40176	7
MP_Heave_Displ	m	-1.0628	0.90911	-0.003087	0.27683	0.55366	8
MP_Heave_Acc	m/s^2	-0.85168	0.76937	-0.053498	0.23967	0.47934	9
MP_Heading_Angle	deg	10.756	27.438	19.671	3.352	6.704	10
MP_Yaw_Vel	deg/s	-3.7486	5.0147	0.15345	1.2719	2.5438	11
MP_Pitch_Angle	deg	-6.8932	2.6846	-1.3239	1.4413	2.8826	12
MP_Pitch_Vel	deg/s	-4.5342	5.0334	0.10002	1.4776	2.9552	13
MP_Roll_Angle	deg	-12.64	10.722	-0.2609	3.7676	7.5352	14
MP_Roll_Vel	deg/s	-21.037	18.222	0.054473	6.2475	12.495	15
Speed	knots	6.2095	8.5142	7.4896	0.22561	0.45122	16

MP_Heave_Acc	m/s^2	ZCA_NWU	294
		ZCA_NWD	295
North Center Wave Probe	m	WAV_HM0	1.12399
	s	SPEC_TPD	7.25904

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal
Run segment from 767 s to 810 s appears to have been inadvertently omitted.

CCGA Atlantic Swell Seakeeping Experiments

Fishing Vessel Safety Proj. 2017 **Model #IOT651** **Scale 1:4.697**
Offshore Engineering Basin **Jan. - Feb. 2005**
Forward Speed = 8 knots full scale
Heading with respect to incident wave = 75 degrees
Run Sequence #10 **MUN WAVE 3** **Wave Direction = 65 degrees w.r.t. south wall.**

Analysis Date/Time	=	4/13/2005 16:22		
Acquired Date/Time	=	2/9/2005 13:15		
Input File	=	SPD8_HDG75		
Output File	=	SPD8_HDG75_STAT		
Number of Samples	=	24391		
Segment Start Time	=	110.40 seconds		
Segment End Time	=	1167.3 seconds		
Segment Total Time	=	1056.9 seconds	=	17.62 minutes

Description	Unit	Min	Max	Mean	Std. Dev.	Sig.	Chan
North Center Wave Probe	m	-1.0739	1.0674	-0.00956	0.3366	0.6732	1
Shaft RPM	RPM	572.02	592.57	582.92	4.3734	8.7468	2
Rudder Angle	deg	-4.5747	5.0615	1.8783	1.2047	2.4094	3
MP_Surge_Displ	m	-1.3165	1.1867	-0.00292	0.4245	0.849	4
MP_Surge_Acc	m/s^2	-0.64344	0.54357	0.044685	0.15666	0.31332	5
MP_Sway_Displ	m	-1.4408	1.2941	0.000717	0.41813	0.83626	6
MP_Sway_Acc	m/s^2	-0.99028	1.1291	0.00589	0.29574	0.59148	7
MP_Heave_Displ	m	-0.95609	1.0451	-0.00373	0.32777	0.65554	8
MP_Heave_Acc	m/s^2	-2.3746	2.6482	-0.05532	0.71272	1.42544	9
MP_Heading_Angle	deg	66.303	87.404	77.26	3.8741	7.7482	10
MP_Yaw_Vel	deg/s	-4.2823	3.9639	0.030345	1.0975	2.195	11
MP_Pitch_Angle	deg	-5.8681	2.6959	-1.1993	1.1955	2.391	12
MP_Pitch_Vel	deg/s	-10.107	9.3511	0.12354	2.6092	5.2184	13
MP_Roll_Angle	deg	-9.5731	9.5166	-0.14629	2.7863	5.5726	14
MP_Roll_Vel	deg/s	-12.684	18.491	0.051247	4.1556	8.3112	15
Speed	knots	6.1413	8.2212	7.4221	0.17377	0.34754	16

MP_Heave_Acc	m/s^2	ZCA_NWU	473
		ZCA_NWD	474
North Center Wave Probe	m	WAV_HM0	1.34641
	s	SPEC_TPD	7.15352

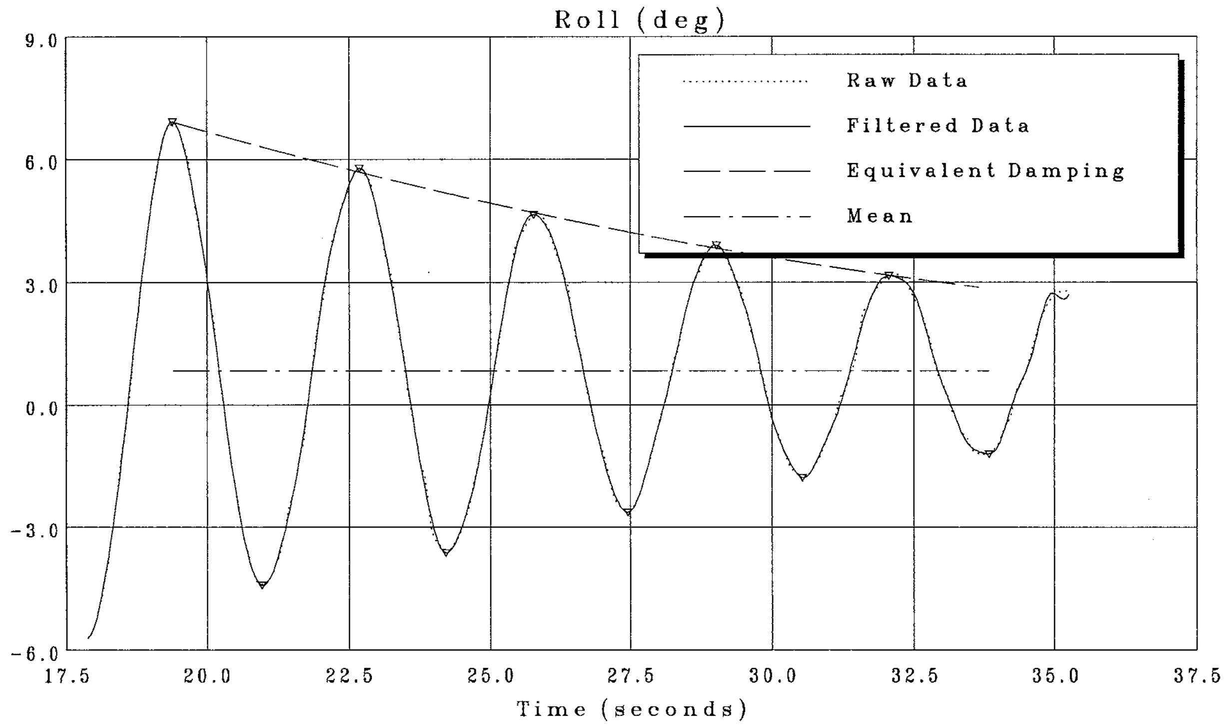
NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO. OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HM0 = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)
Std. Dev. = STANDARD DEVIATION
Sig. = SIGNIFICANT VALUE = 2 * Std. Dev.
MP_ = MotionPak Signal

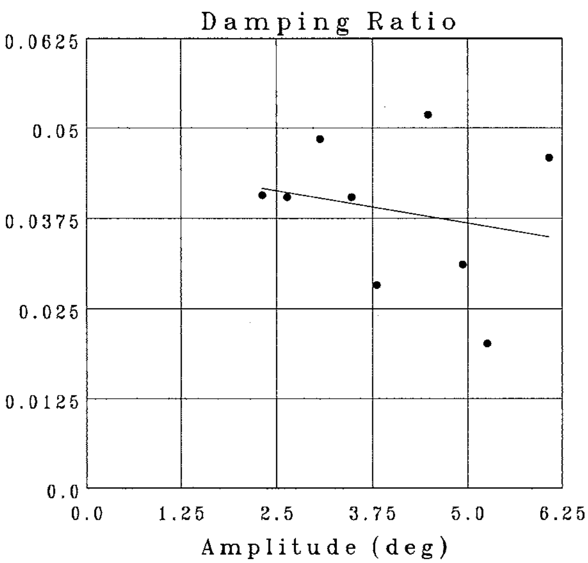
APPENDIX J: ROLL AND PITCH DECAY ANALYSIS RESULTS

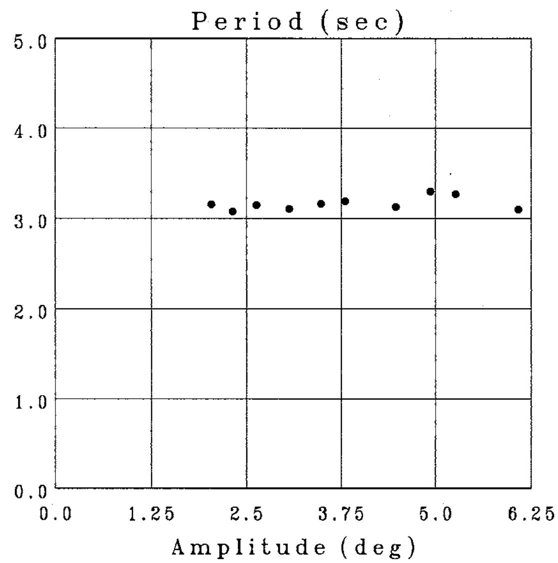
IOT

Fishing Vessel Safety
CCGA Atlantic Swell

Analyzed: 25-FEB-2005 08:51:26
Acquired: 25-JAN-2005 13:49:39







MEAN	DAMPING
Offset = 0.8349 deg	Linear = 0.03863
Period = 3.166 sec	Equivalent B1 = 0.04578
	Equivalent B2 = -0.001785

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.8349	3.1658	0.03863	-0.00179	0.04578

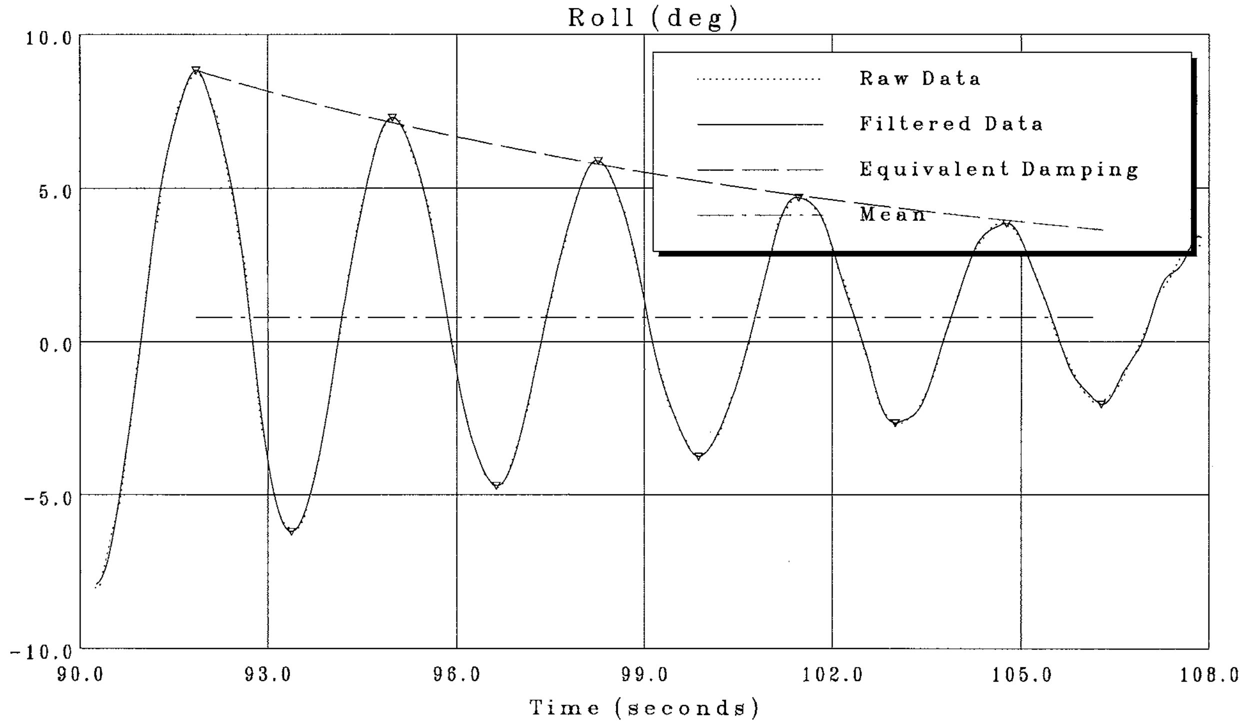
Roll (deg)

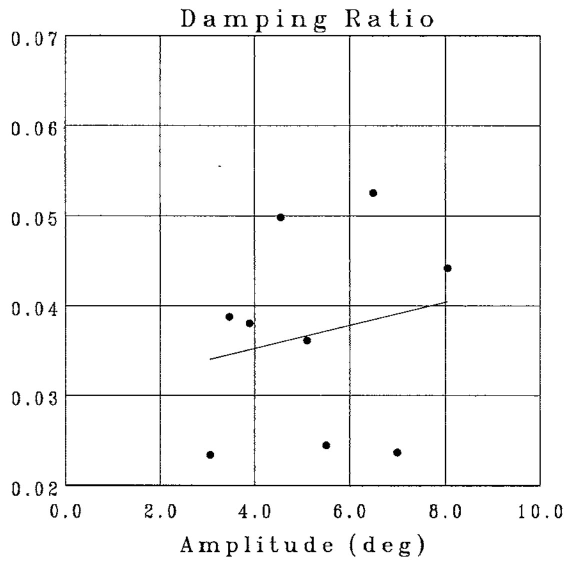
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.9121	6.0772	0.04593	3.1017
-4.4249	5.2598	0.02017	3.2701
5.7717	4.9368	0.03118	3.3012
-3.6410	4.4759	0.05188	3.1268
4.6368	3.8019	0.02829	3.1962
-2.6435	3.4784	0.04047	3.1679
3.8977	3.0628	0.04853	3.1067
-1.7944	2.6293	0.04048	3.1484
3.1499	2.3150	0.04074	3.0824
-1.2017	2.0367		3.1559

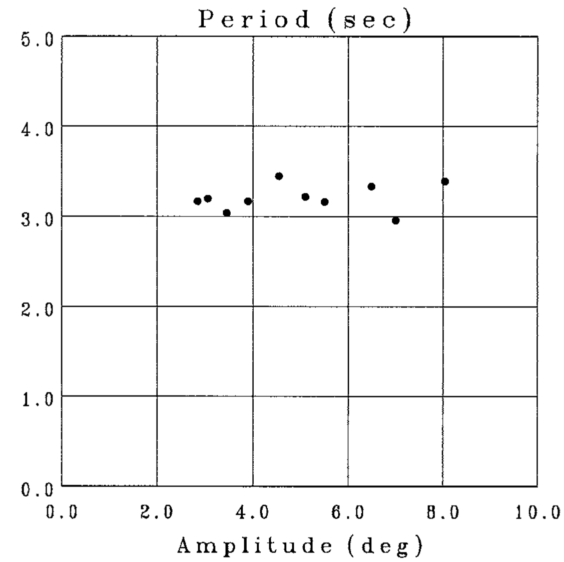
IOT

Fishing Vessel Safety
CCGA Atlantic Swell

Analyzed: 25-FEB-2005 08:55:52
Acquired: 25-JAN-2005 13:49:39







MEAN	DAMPING
Offset = 0.7949 deg	Linear = 0.03678
Period = 3.211 sec	Equivalent B1 = 0.03005
	Equivalent B2 = 0.001287

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.7949	3.2107	0.03678	0.00129	0.03005

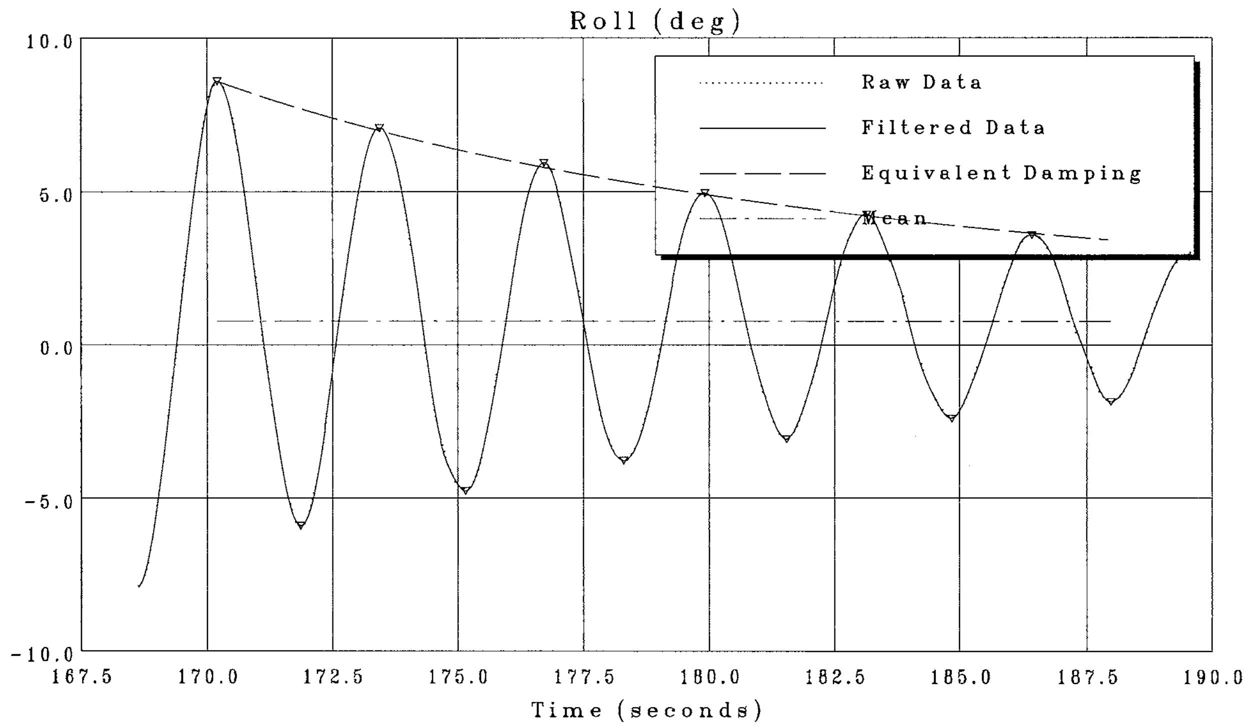
Roll (deg)

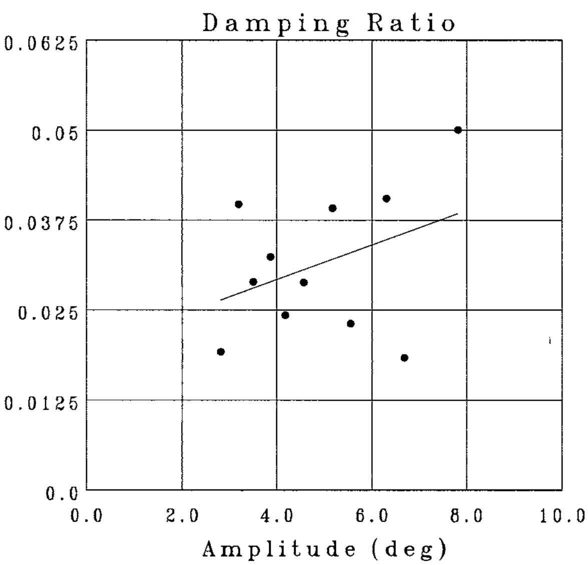
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
8.8339	8.0389	0.04417	3.3909
-6.2015	6.9964	0.02368	2.9586
7.2895	6.4946	0.05255	3.3358
-4.7100	5.5049	0.02446	3.1624
5.8925	5.0976	0.03615	3.2232
-3.7551	4.5500	0.04985	3.4494
4.6846	3.8896	0.03804	3.1729
-2.6563	3.4512	0.03874	3.0428
3.8504	3.0555	0.02335	3.1983
-2.0443	2.8392		3.1727

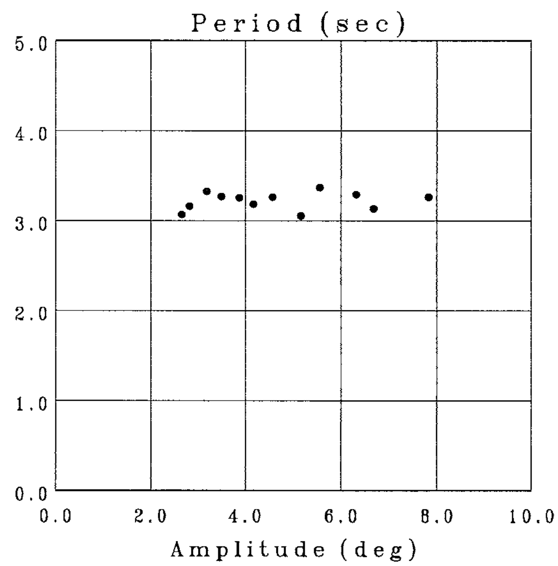
IOT

Fishing Vessel Safety
CCGA Atlantic Swell

Analyzed: 25-FEB-2005 08:57:14
Acquired: 25-JAN-2005 13:49:39







MEAN	DAMPING
Offset = 0.7812 deg	Linear = 0.03132
Period = 3.222 sec	Equivalent B1 = 0.01957
	Equivalent B2 = 0.002412

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.7812	3.2222	0.03132	0.00241	0.01957

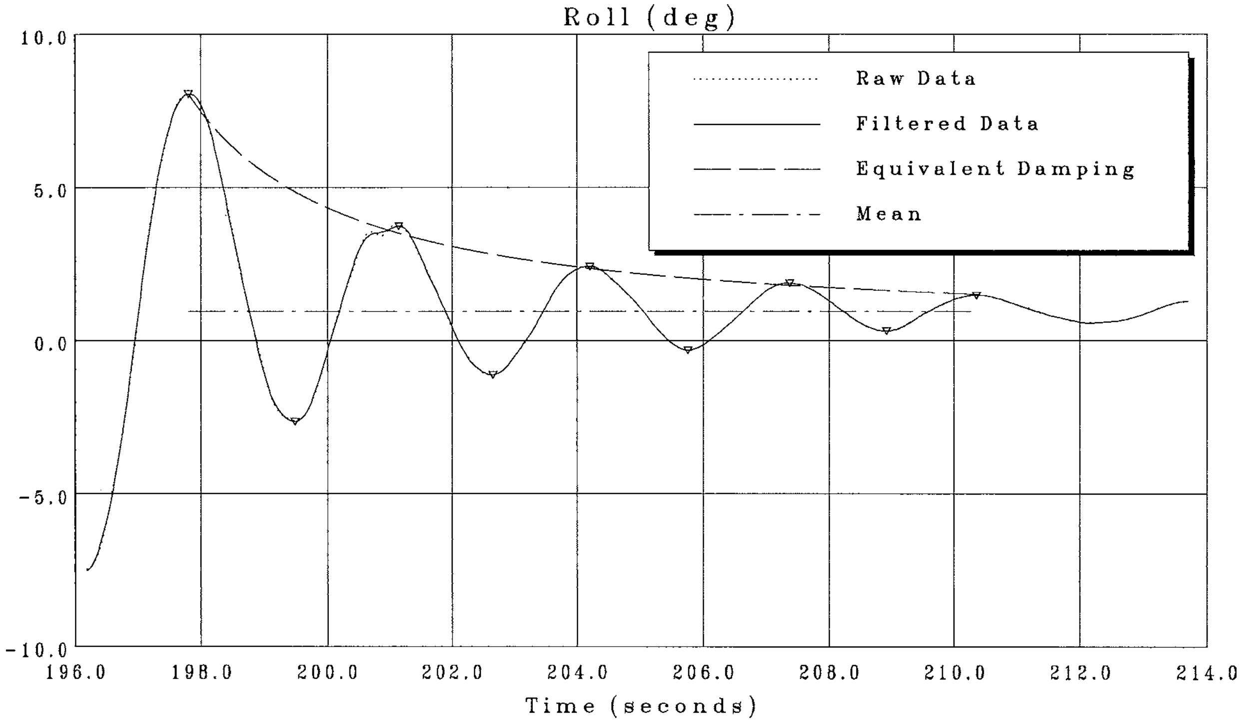
Roll (deg)

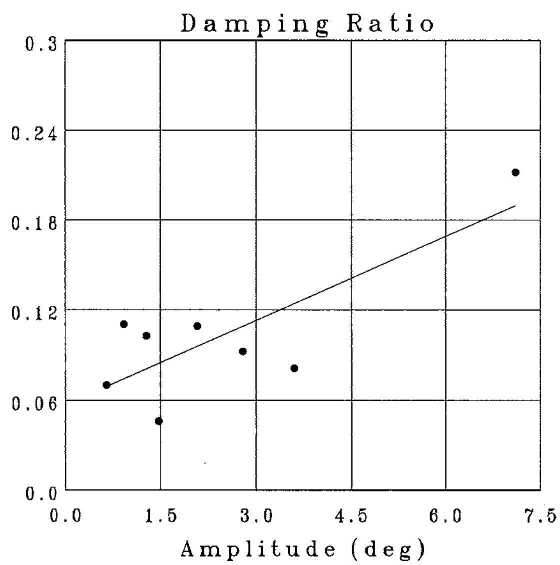
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
8.6026	7.8214	0.05012	3.2646
-5.8994	6.6806	0.01834	3.1382
7.0878	6.3066	0.04052	3.2923
-4.7710	5.5522	0.02312	3.3716
5.9443	5.1631	0.03917	3.0549
-3.7836	4.5648	0.02885	3.2621
4.9503	4.1691	0.02429	3.1879
-3.0815	3.8627	0.03236	3.2585
4.2703	3.4891	0.02888	3.2740
-2.4052	3.1864	0.03978	3.3326
3.5929	2.8117	0.01913	3.1619
-1.8665	2.6477		3.0682

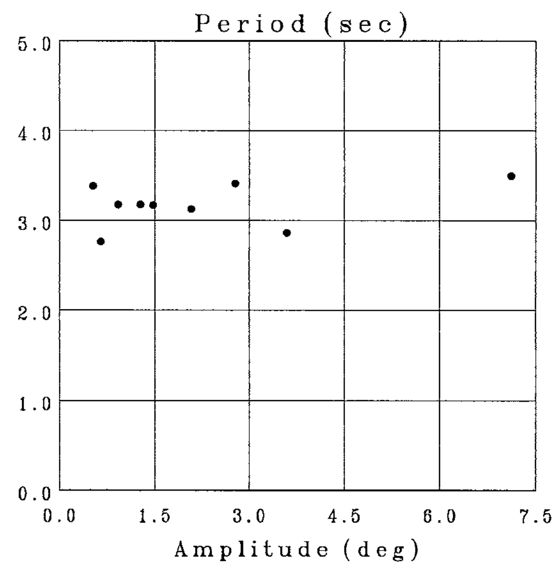
IOT

Fishing Vessel Safety
CCGA ATLANTIC SWELL

Analyzed: 25-FEB-2005 09:02:00
Acquired: 25-JAN-2005 14:01:02







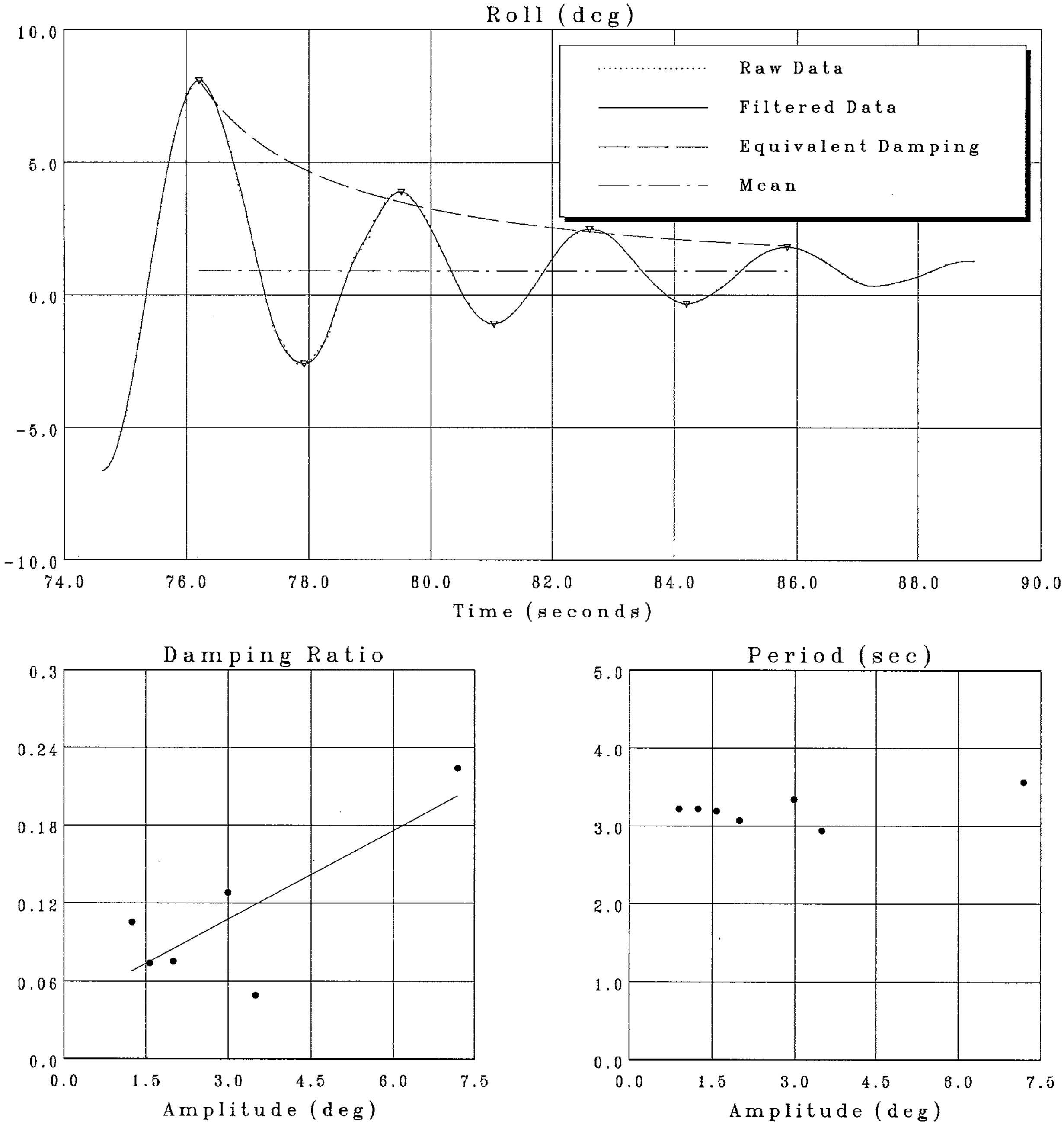
MEAN	DAMPING
Offset = 0.9492 deg	Linear = 0.1031
Period = 3.175 sec	Equivalent B1 = 0.05664
	Equivalent B2 = 0.01869

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.9492	3.1749	0.10306	0.01869	0.05664

Roll (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
8.0596	7.1104	0.21229	3.4981
-2.6441	3.5933	0.08127	2.8607
3.7305	2.7813	0.09247	3.4122
-1.1283	2.0775	0.10936	3.1273
2.4195	1.4703	0.04610	3.1734
-0.3227	1.2719	0.10259	3.1801
1.8691	0.9199	0.11048	3.1758
0.3005	0.6487	0.06990	2.7615
1.4697	0.5205		3.3853



MEAN	DAMPING
Offset = 0.8998 deg	Linear = 0.1093
Period = 3.224 sec	Equivalent B1 = 0.03925
	Equivalent B2 = 0.02275

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.8998	3.2236	0.10929	0.02275	0.03925

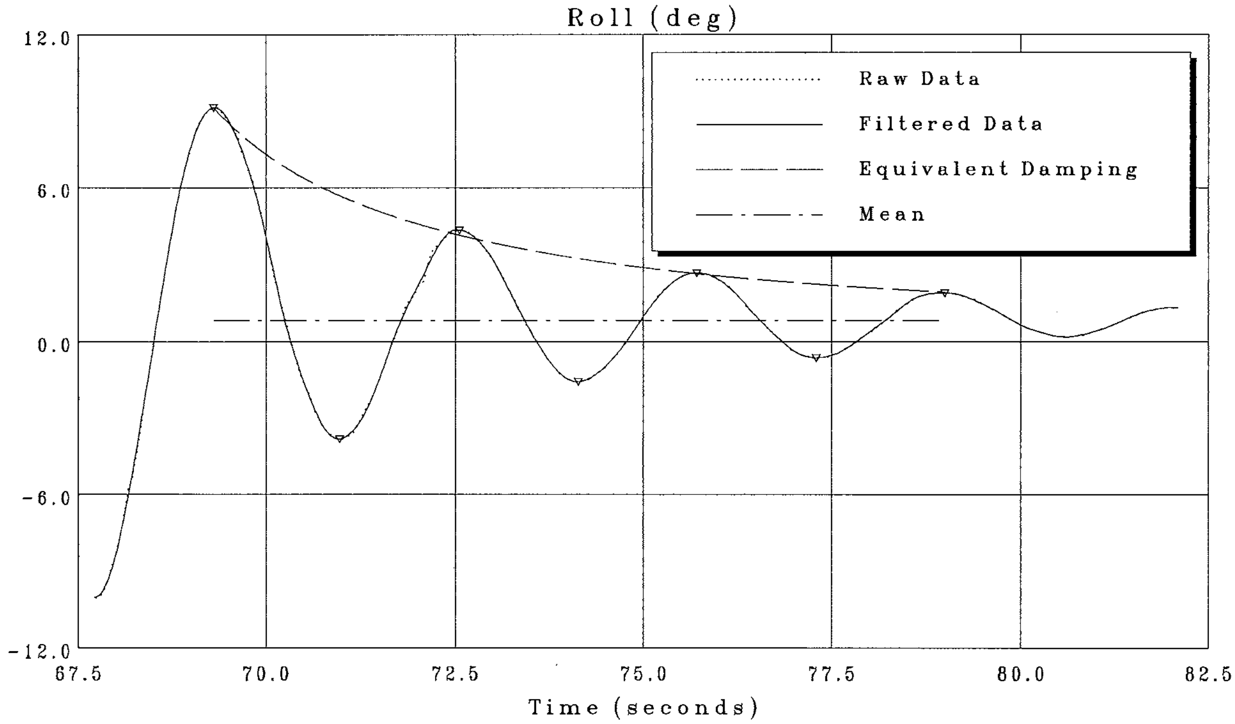
Roll (deg)

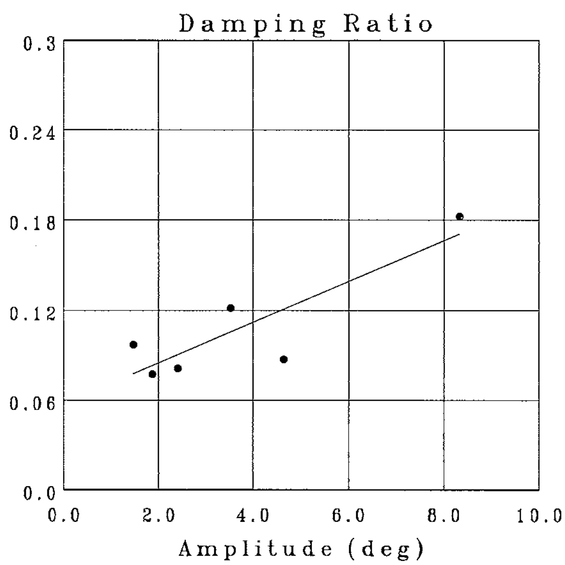
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
8.0829	7.1830	0.22406	3.5662
-2.5886	3.4884	0.04925	2.9438
3.8875	2.9877	0.12790	3.3454
-1.0926	1.9925	0.07526	3.0742
2.4717	1.5719	0.07391	3.1959
-0.3455	1.2454	0.10535	3.2203
1.7926	0.8928		3.2196

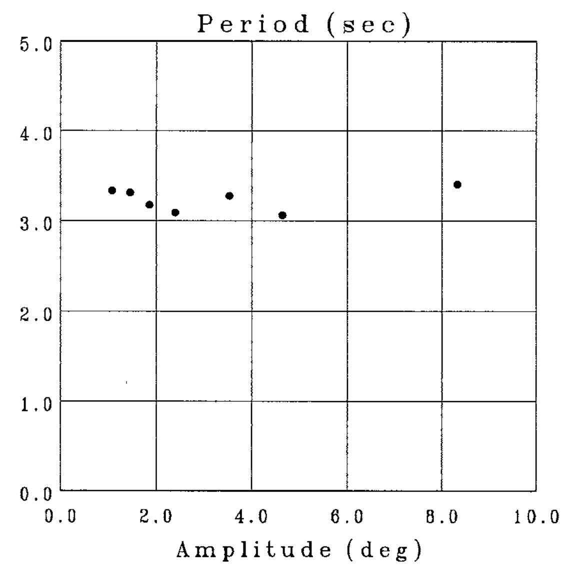
IOT

Fishing Vessel Safety
CCGA ATLANTIC SWELL

Analyzed: 25-FEB-2005 09:04:42
Acquired: 25-JAN-2005 14:07:06







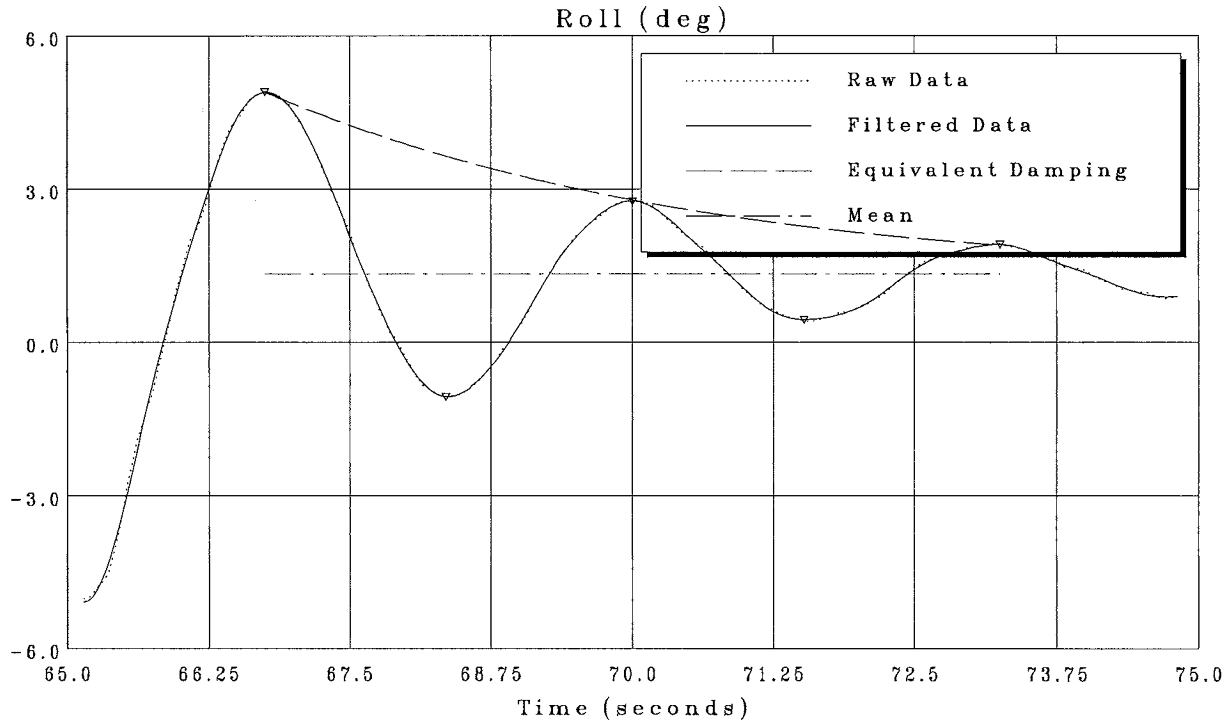
MEAN	DAMPING
Offset = 0.8211 deg	Linear = 0.1078
Period = 3.239 sec	Equivalent B1 = 0.05775
	Equivalent B2 = 0.01353

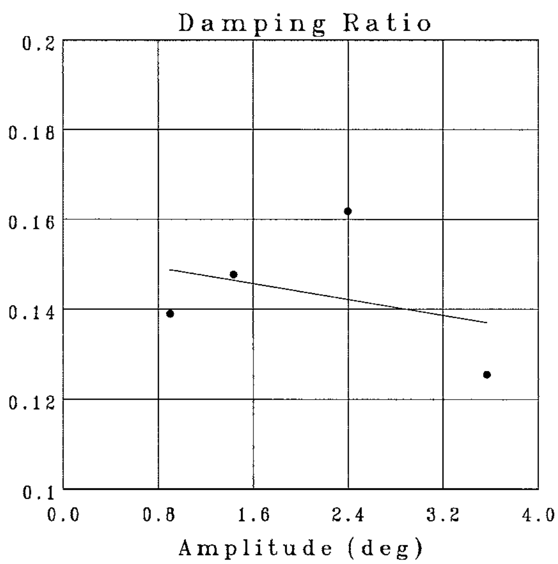
Roll (deg)

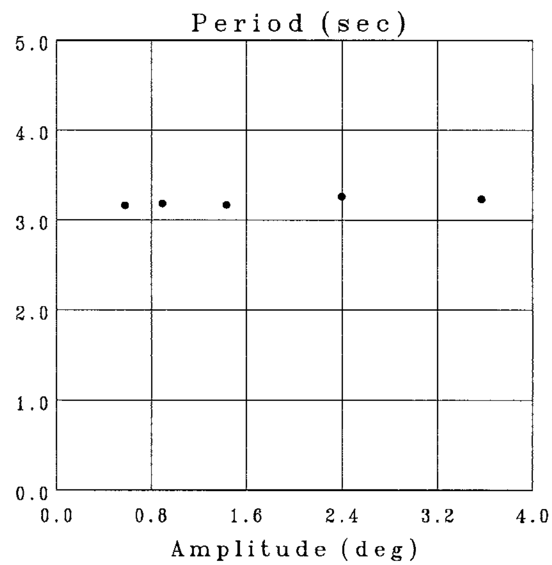
Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.8211	3.2393	0.10784	0.01353	0.05775

Roll (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
9.1432	8.3221	0.18248	3.4091
-3.8242	4.6452	0.08748	3.0628
4.3463	3.5253	0.12157	3.2793
-1.5782	2.3993	0.08113	3.0919
2.6790	1.8579	0.07738	3.1809
-0.6348	1.4559	0.09698	3.3147
1.8930	1.0720		3.3365







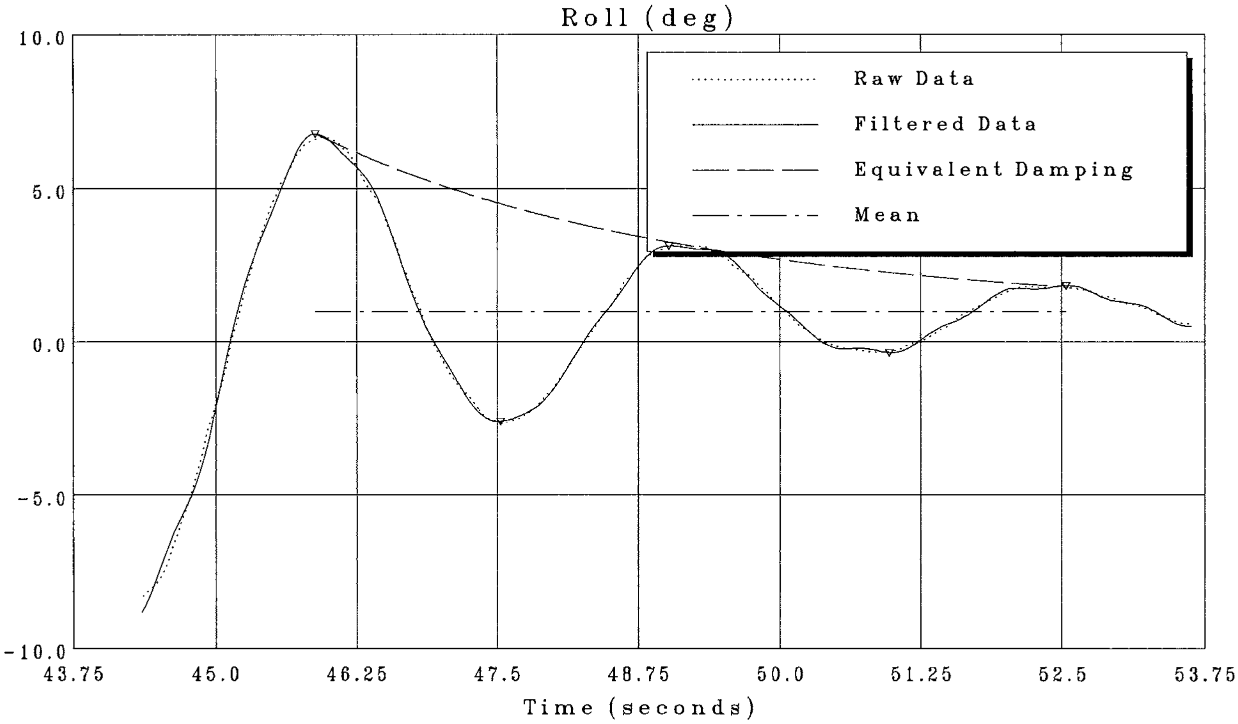
MEAN	DAMPING
Offset = 1.334 deg	Linear = 0.1435
Period = 3.205 sec	Equivalent B1 = 0.1526
	Equivalent B2 = -0.004387

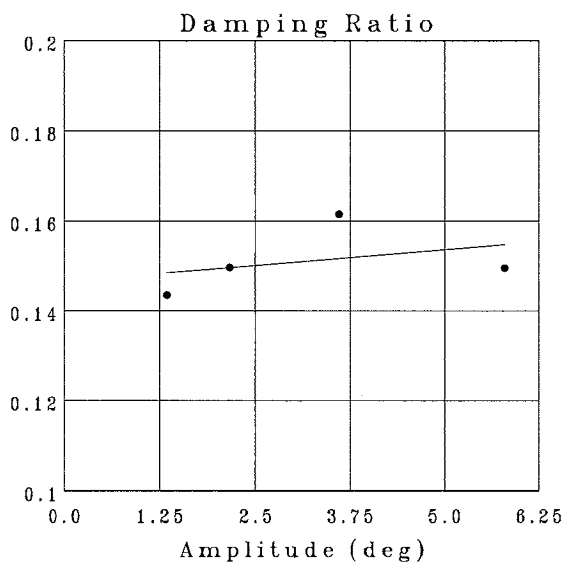
Roll (deg)

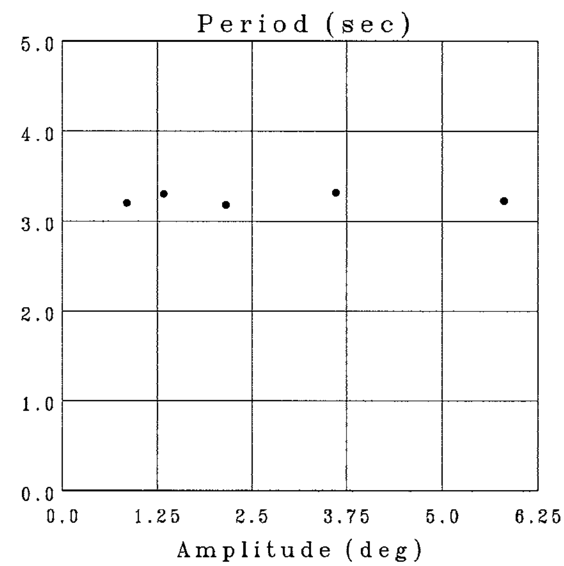
Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
1.3341	3.2047	0.14350	-0.00439	0.15259

Roll (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
4.9017	3.5676	0.12552	3.2372
-1.0634	2.3975	0.16193	3.2629
2.7659	1.4318	0.14763	3.1694
0.4383	0.8958	0.13891	3.1868
1.9106	0.5765		3.1670







MEAN	DAMPING
Offset = 0.9787 deg	Linear = 0.1511
Period = 3.251 sec	Equivalent B1 = 0.1466
	Equivalent B2 = 0.001386

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.9787	3.2505	0.15108	0.00139	0.14661

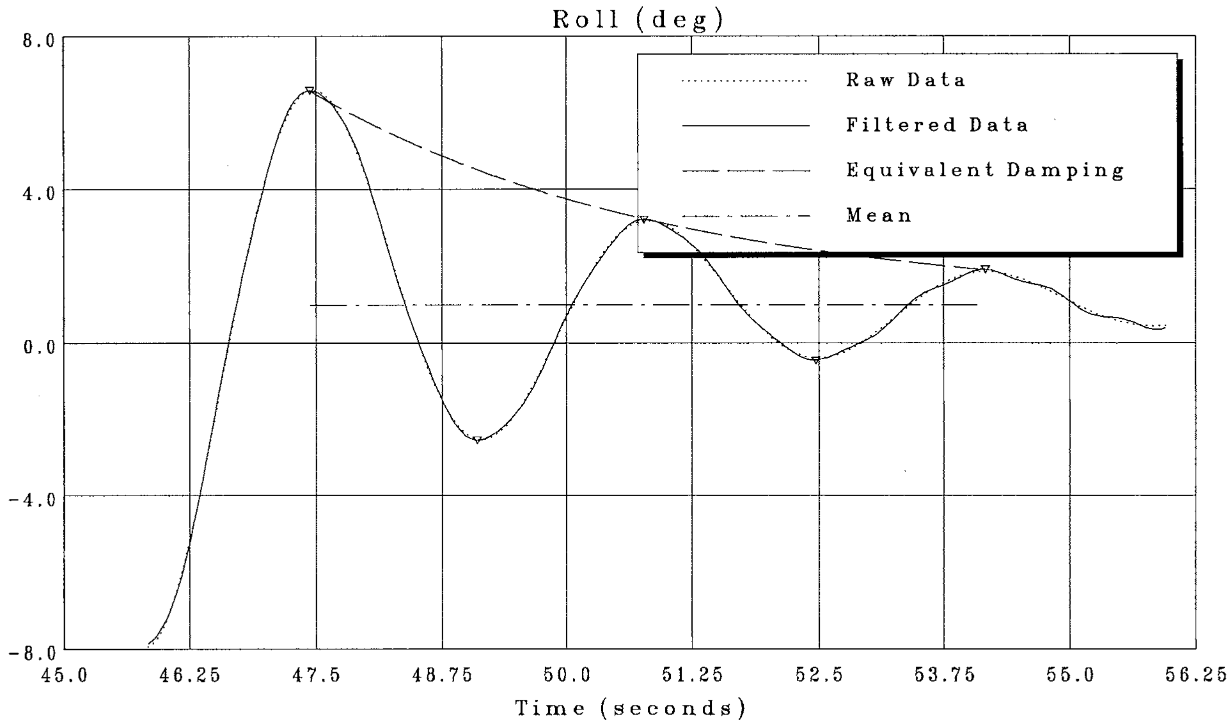
Roll (deg)

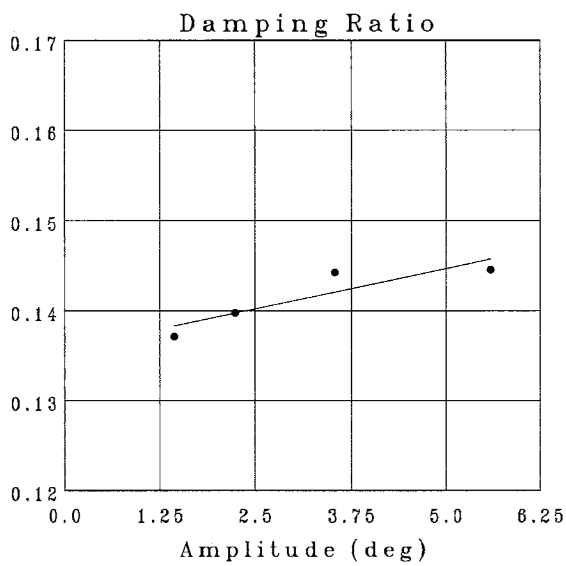
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.7777	5.7991	0.14959	3.2323
-2.6266	3.6053	0.16156	3.3207
3.1343	2.1557	0.14964	3.1890
-0.3613	1.3399	0.14354	3.3063
1.8282	0.8496		3.2043

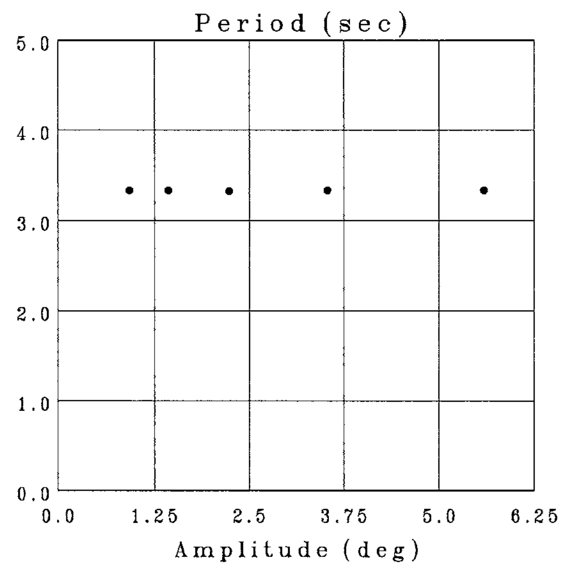
IOT

Fishing Vessel Safety
CCGA ATLANTIC SWELL

Analyzed: 25-FEB-2005 09:07:25
Acquired: 25-JAN-2005 14:23:06







MEAN	DAMPING
Offset = 0.9801 deg	Linear = 0.1414
Period = 3.337 sec	Equivalent B1 = 0.1357
	Equivalent B2 = 0.001793

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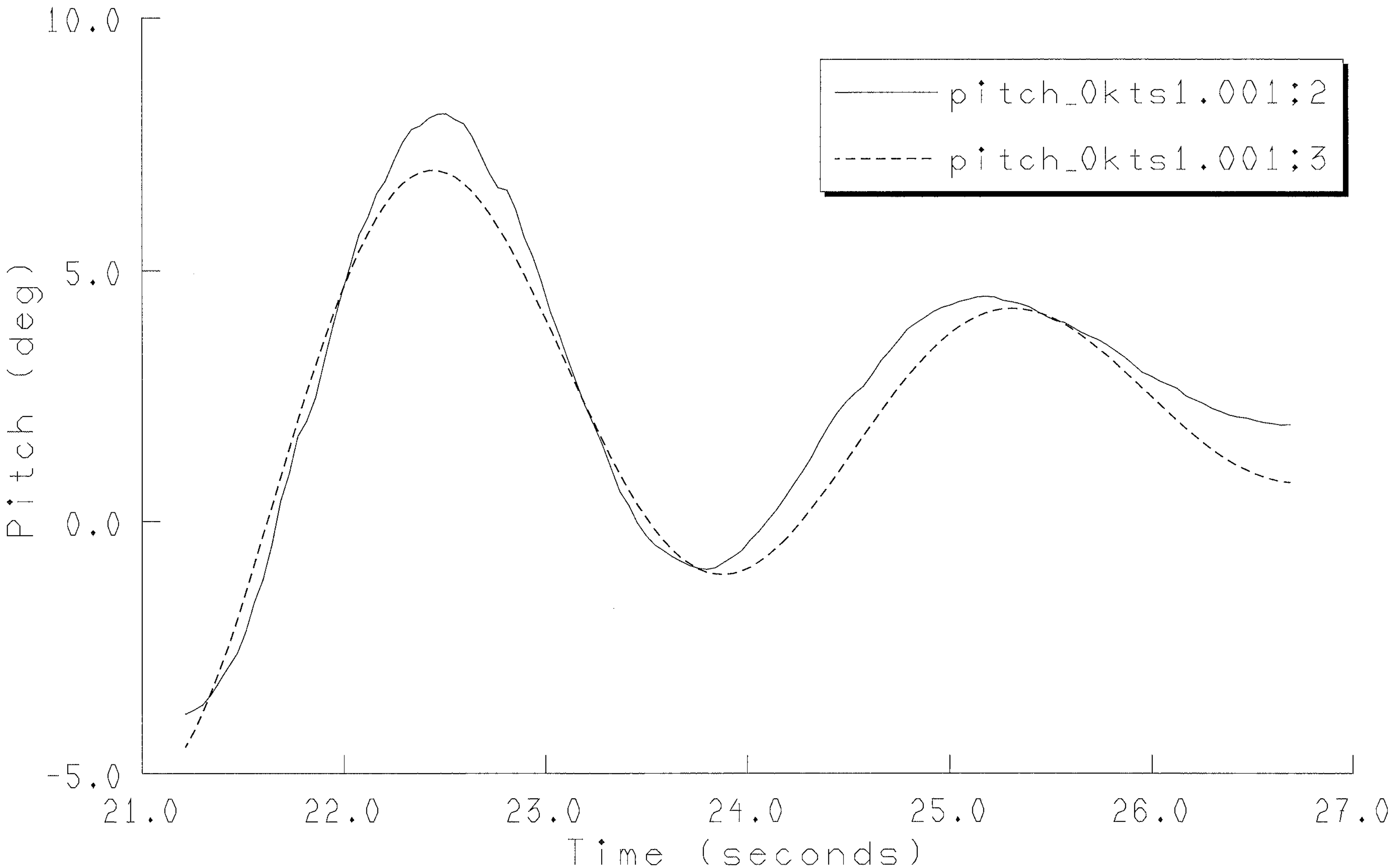
Roll
roll_8knts_007

Roll (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.9801	3.3366	0.14144	0.00179	0.13571

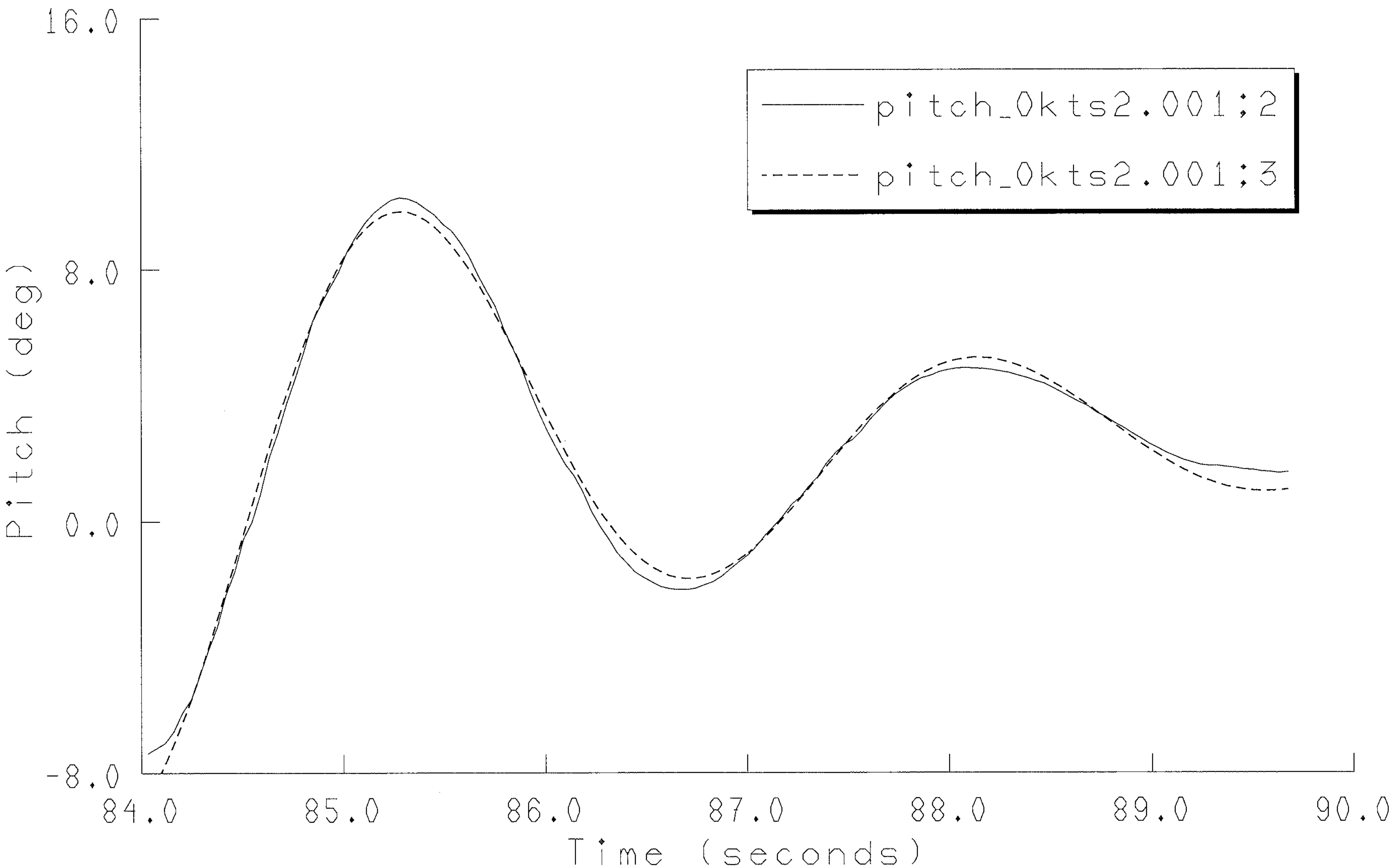
Roll (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.5707	5.5906	0.14460	3.3394
-2.5523	3.5324	0.14427	3.3396
3.2145	2.2344	0.13978	3.3313
-0.4539	1.4340	0.13712	3.3375
1.9084	0.9283		3.3350

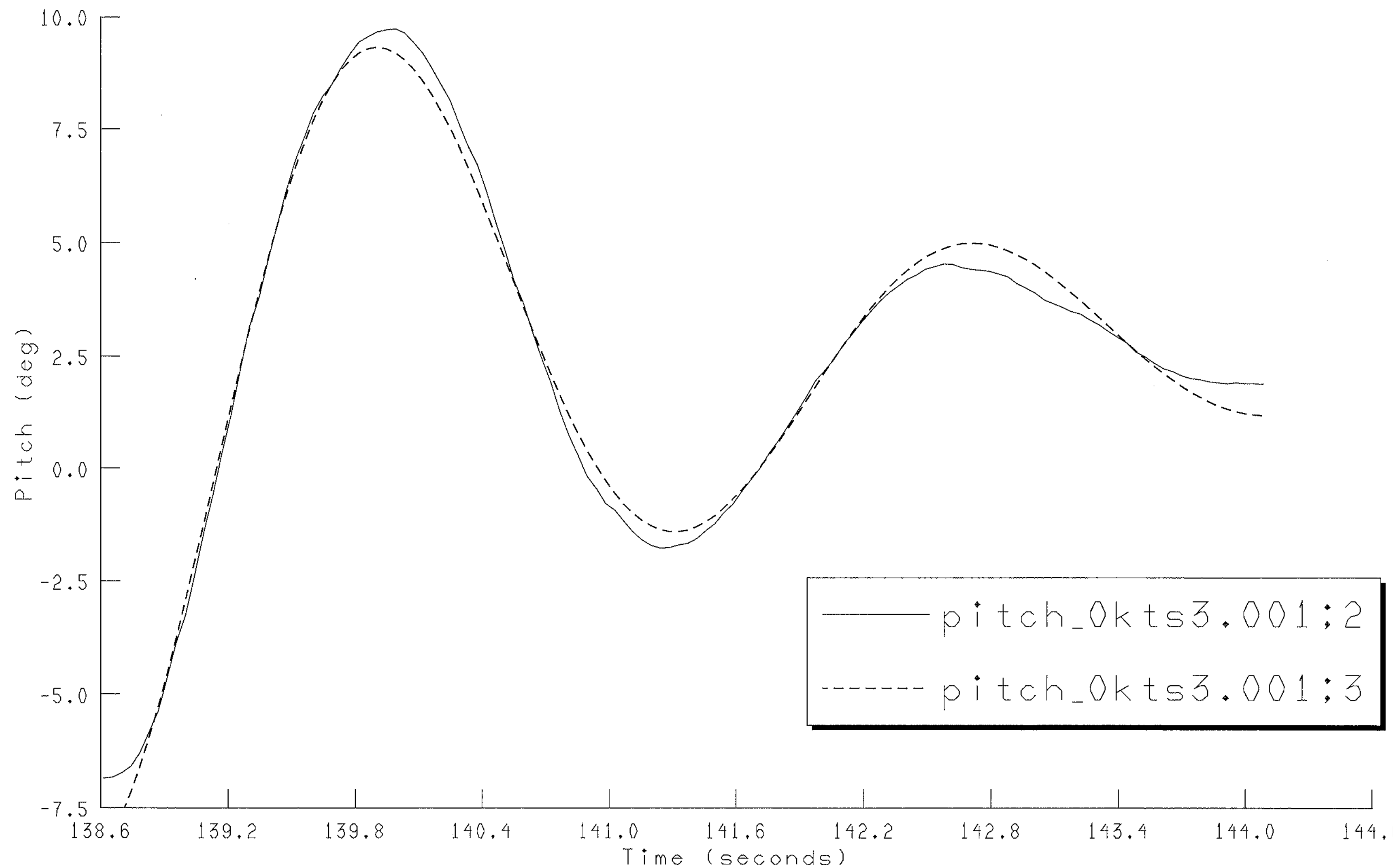


pitch_0kts1.001;2
pitch_0kts1.001;3
10.0
5.0
0.0
-5.0
Pitch (deg)
21.0
22.0
23.0
24.0
25.0
26.0
27.0
Time (seconds)

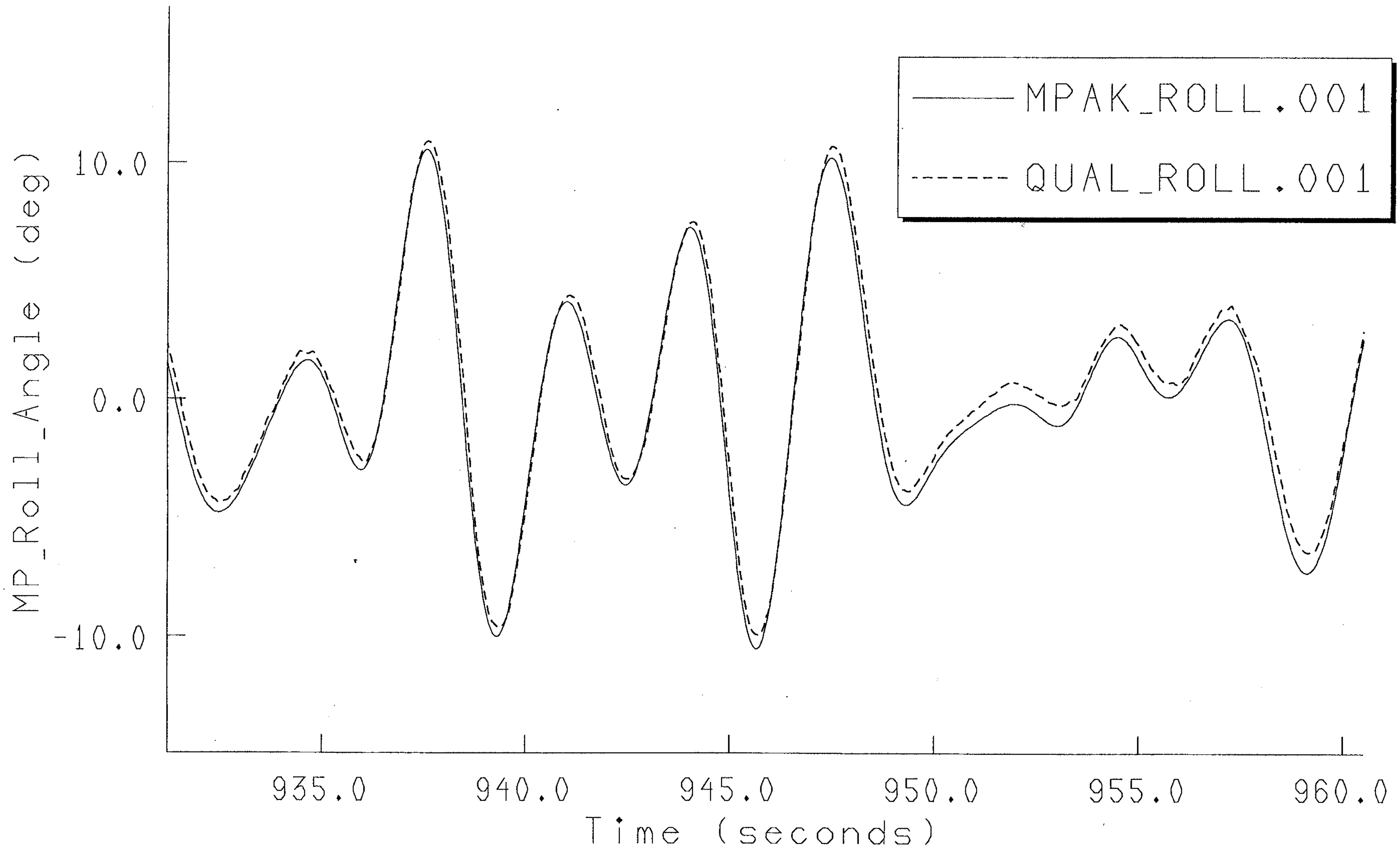
[CUMMINGD.TMP] Test No. pitch_0knts_001 24-FEB-2005 08:33



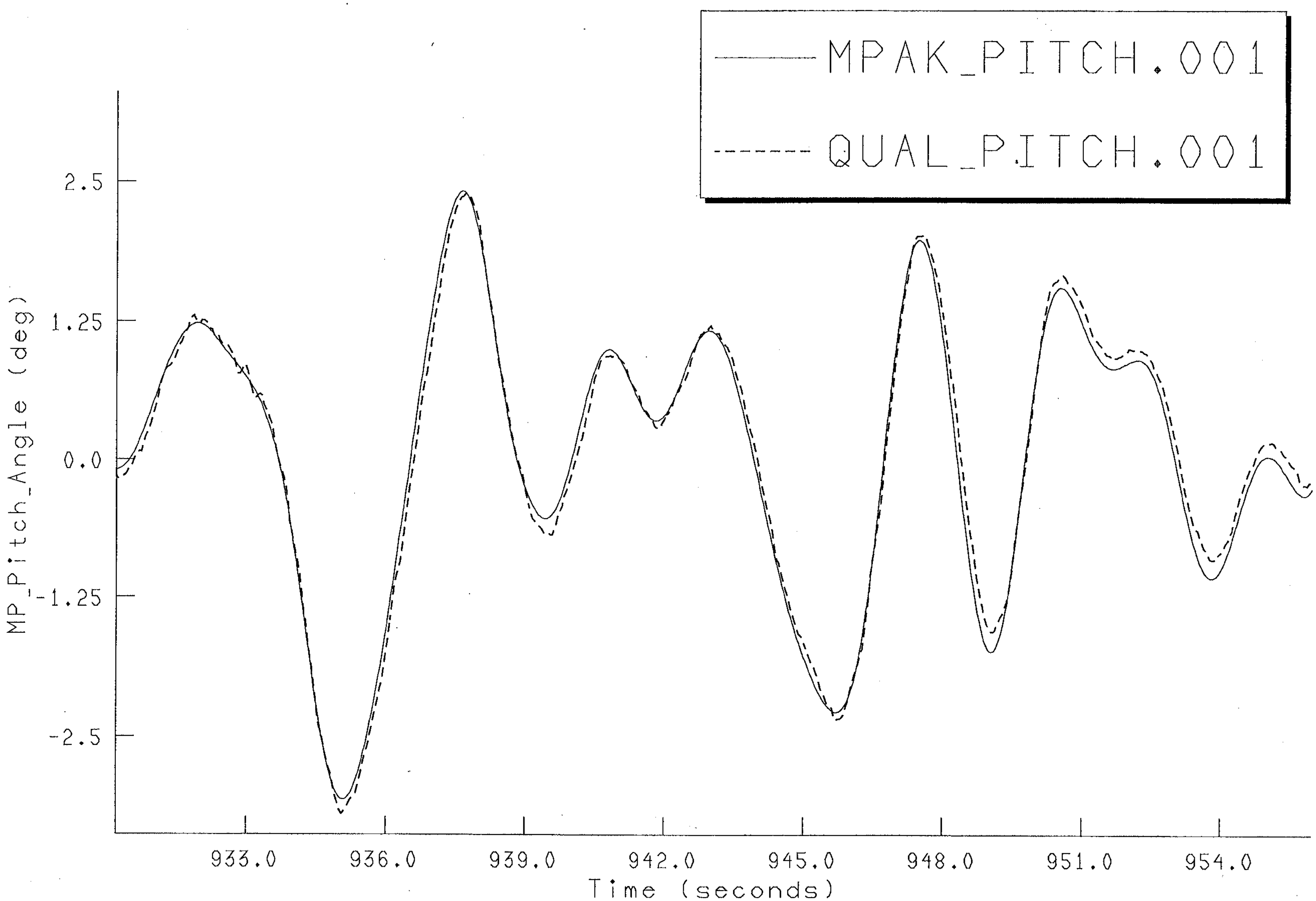
[CUMMINGD.TMP] Test No. pitch_0knts_001 24-FEB-2005 08:33

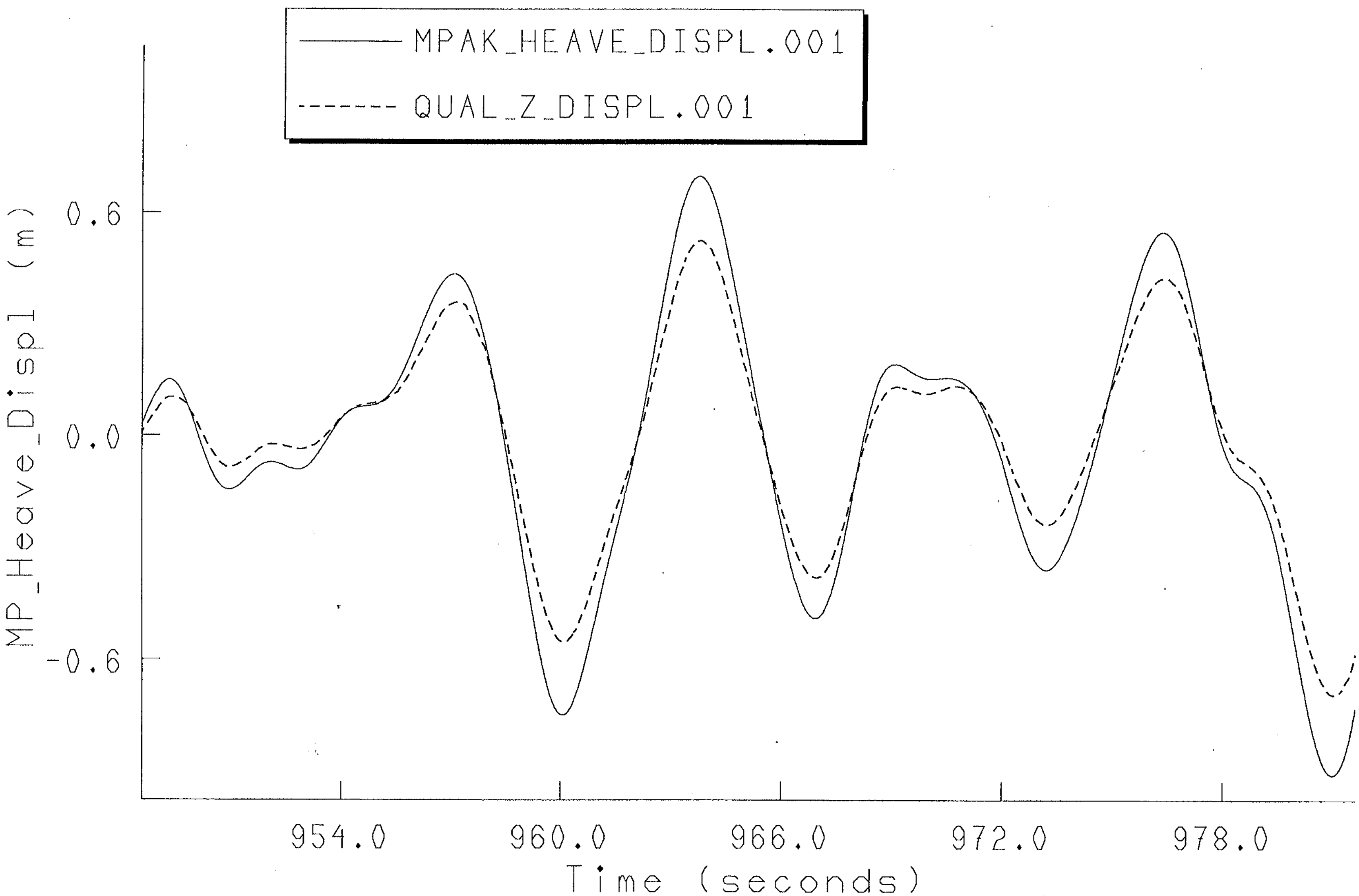


APPENDIX K: PLOTS RELATED TO SEAKEEPING DATA VERIFICATION PROCESS

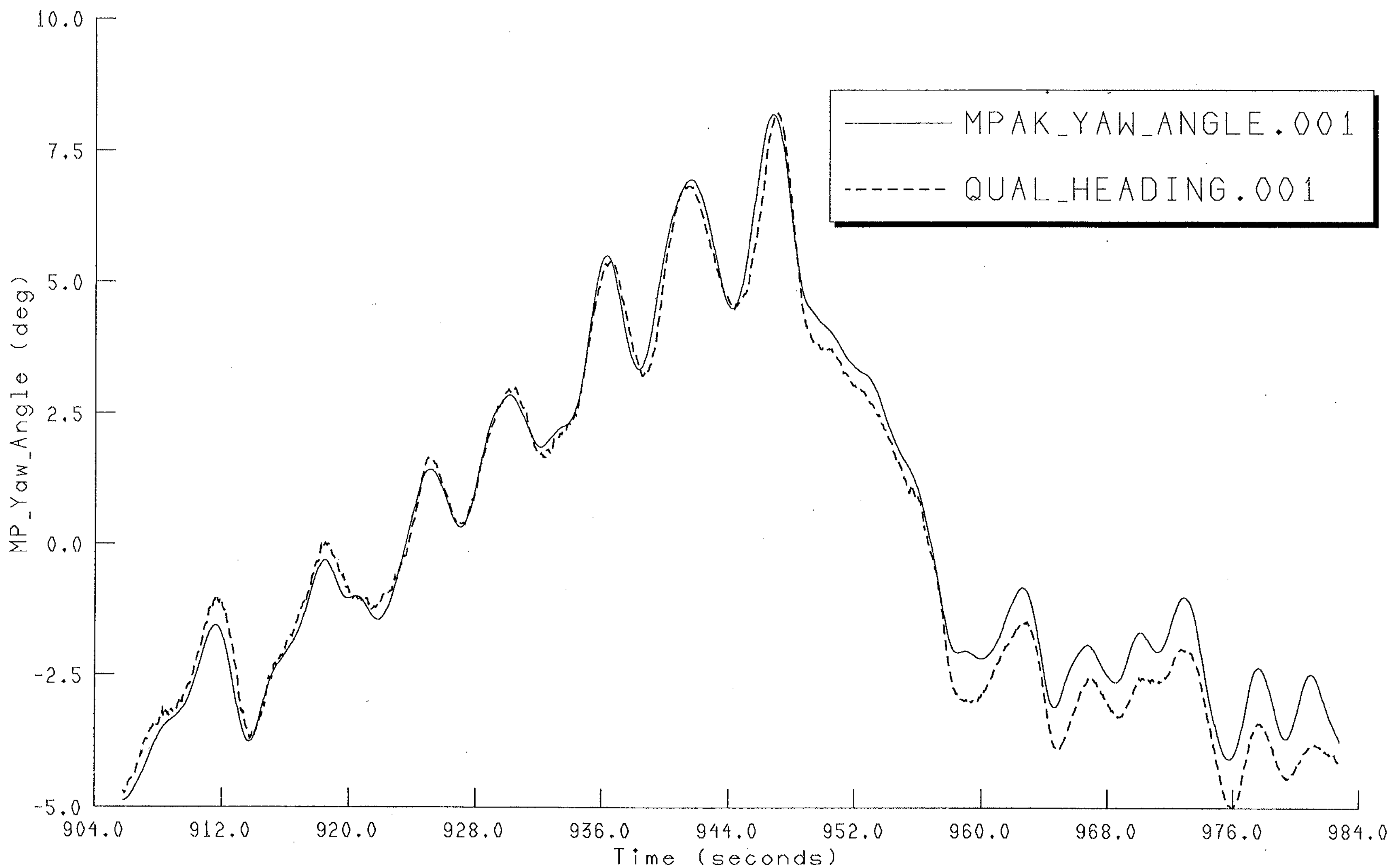

MPAK_ROLL.001
QUAL_ROLL.001
MP_Roll_Angle (deg)
10.0
0.0
-10.0
935.0
940.0
945.0
950.0
955.0
960.0
Time (seconds)

Test No. run_211

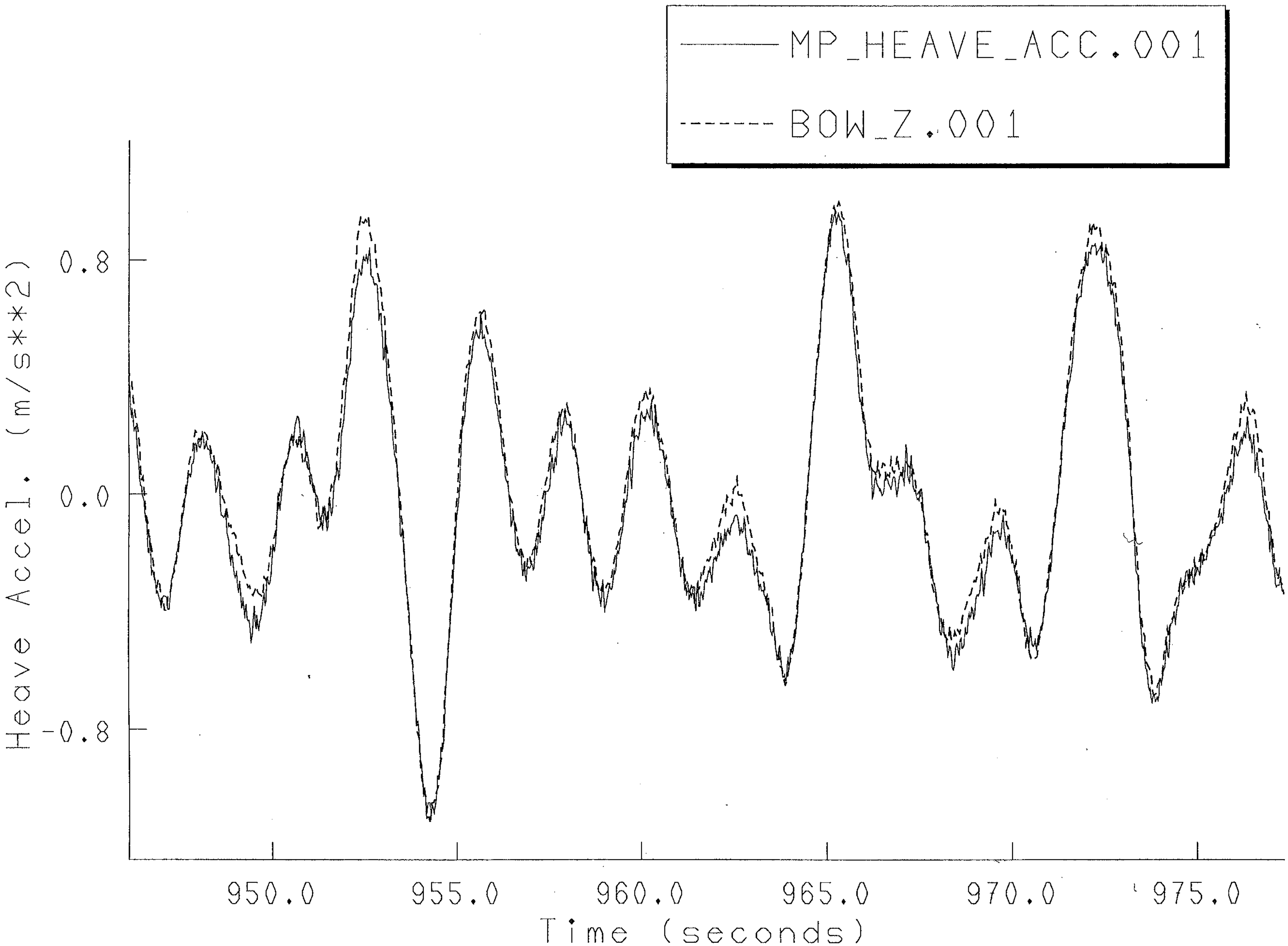


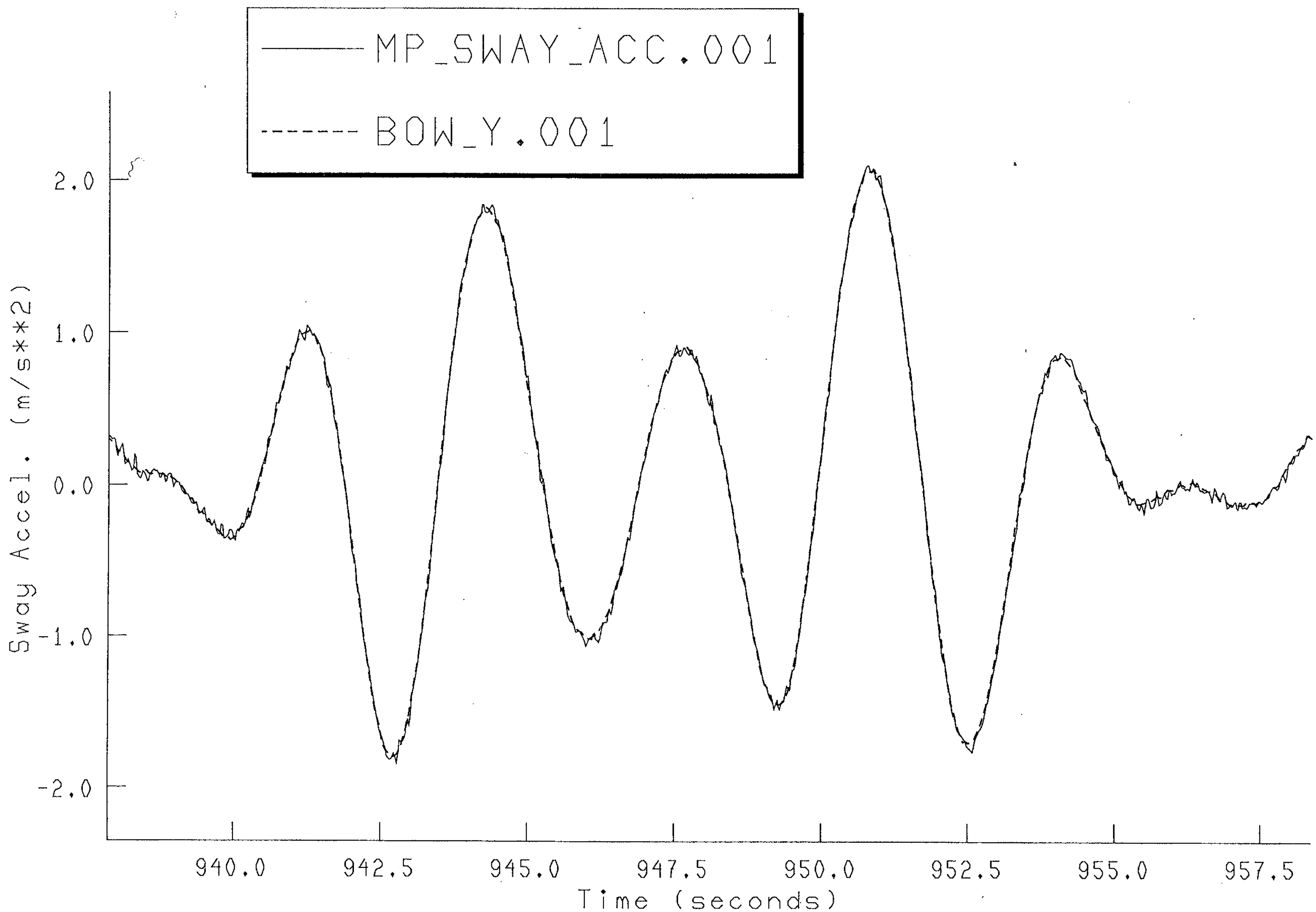

MPAK_HEAVE_DISPL.001
QUAL_Z_DISPL.001
MP_Heave_Displ (m)
0.6
0.0
-0.6
954.0
960.0
966.0
972.0
978.0
Time (seconds)

Test No. run_211



Test No. run_211




MP_SWAY_ACC.001
BOW_Y.001
2.0
1.0
0.0
-1.0
-2.0
Sway Accel. (m/s**2)
940.0
942.5
945.0
947.5
950.0
952.5
955.0
957.5
Time (seconds)

APPENDIX L: SUMMARY OF OEB CALIBRATED WAVE STATISTICS

CCGA ATLANTIC SWELL SEAKEEPING EXPERIMENTS

Fishing Vessel Research Proj. 2017 **Jan./Feb. 2005**

Summary of Calibrated Wave Statistics **Offshore Engineering Basin**

Wave #	Direction (deg.)	Wave File Name	Calibration Probe H_s (m)	Calibration Probe Tpd (s)	Target H_s (m)	Target Tpd (s)	% Difference from Target H_s (m)	% Difference from Target Tpd (s)
1	25	MUN25_WAVE1_002	1.4248	7.3720	1.5100	7.4200	5.642	0.647
1	25F	MUN25F_WAVE1_002	1.4540	7.4041	1.5100	7.4200	3.709	0.214
2	25	MUN25_WAVE2_007	1.3373	7.4033	1.3700	7.4200	2.387	0.225
2	65	MUN65_WAVE2_005	1.3322	7.2092	1.3700	7.4200	2.759	2.841
2	65F	MUN65F_WAVE2_002	1.2984	7.4437	1.3700	7.4200	5.226	0.319
3	25	MUN25_WAVE3_006	1.2228	7.5934	1.2500	7.4200	2.176	2.337
3	25F	MUN25F_WAVE3_004	1.2384	7.6020	1.2500	7.4200	0.928	2.453
3	65	MUN65_WAVE3_006	1.2435	7.5663	1.2500	7.4200	0.520	1.972
2	25	IOT25_WAVE2_002	1.3501	7.3913	1.3700	7.4200	1.453	0.387
2	65	IOT65_WAVE2_002	1.3158	7.3066	1.3700	7.4200	3.956	1.528
3	25	IOT25_WAVE3_003	1.2458	7.5468	1.2500	7.4200	0.336	1.709

Wave #	Direction (deg.)	Wave File Name	North Center Probe H_s (m)	North Center Probe Tpd (s)	% Difference from Cal Probe H_s (m)	% Difference from Cal Probe Tpd (s)	% Difference from Target H_s (m)	% Difference from Target Tpd (s)
1	25	MUN25_WAVE1_002	1.3758	7.4605	3.439	1.200	8.887	0.546
1	25F	MUN25F_WAVE1_002	1.4061	8.3099	3.294	12.234	6.881	11.993
2	25	MUN25_WAVE2_007	1.2494	7.1085	6.573	3.982	8.803	4.198
2	65	MUN65_WAVE2_005	1.3467	7.0718	1.088	1.906	1.701	4.693
2	65F	MUN65F_WAVE2_002	1.4161	7.9475	9.065	6.768	3.365	7.109
3	25	MUN25_WAVE3_006	1.1753	7.6421	3.885	0.641	5.976	2.993
3	25F	MUN25F_WAVE3_004	0.9912	7.9544	19.961	4.636	20.704	7.202
3	65	MUN65_WAVE3_006	1.3562	7.6488	9.063	1.090	8.496	3.084
2	25	IOT25_WAVE2_002	1.2106	7.5624	10.333	2.315	11.635	1.919
2	65	IOT65_WAVE2_002	1.3897	7.5528	5.616	3.370	1.438	1.790
3	25	IOT25_WAVE3_003	1.1169	7.5627	10.347	0.211	10.648	1.923

Wave #	Direction (deg.)	Wave File Name	South East Probe H_s (m)	South East Probe Tpd (s)	% Difference from Cal Probe H_s (m)	% Difference from Cal Probe Tpd (s)	% Difference from Target H_s (m)	% Difference from Target Tpd (s)
1	25	MUN25_WAVE1_002	1.4900	8.3215	4.576	12.880	1.325	12.150
1	25F	MUN25F_WAVE1_002	1.5620	9.4017	7.428	26.980	3.444	26.708
2	25	MUN25_WAVE2_007	1.3822	8.6482	3.358	16.815	0.891	16.553
2	65	MUN65_WAVE2_005	1.2715	7.3779	4.556	2.340	7.190	0.567
2	65F	MUN65F_WAVE2_002	1.3902	9.4427	7.070	26.855	1.474	27.260
3	25	MUN25_WAVE3_006	1.1279	7.9831	7.761	5.132	9.768	7.589
3	25F	MUN25F_WAVE3_004	1.0405	6.7702	15.980	10.942	16.760	8.757
3	65	MUN65_WAVE3_006	1.2855	7.9655	3.378	5.276	2.840	7.352
2	25	IOT25_WAVE2_002	1.2920	7.5389	4.303	1.997	5.693	1.602
2	65	IOT65_WAVE2_002	1.3362	7.8755	1.550	7.786	2.467	6.139
3	25	IOT25_WAVE3_003	1.1790	7.8811	5.362	4.430	5.680	6.214

Wave #	Direction (deg.)	Wave File Name	South Center Probe H_s (m)	South Center Probe Tpd (s)	% Difference from Cal Probe H_s (m)	% Difference from Cal Probe Tpd (s)	% Difference from Target H_s (m)	% Difference from Target Tpd (s)
1	25	MUN25_WAVE1_002	1.4168	7.6597	0.561	3.903	6.172	3.230
1	25F	MUN25F_WAVE1_002	1.5058	9.4571	3.563	27.728	0.278	27.454
2	25	MUN25_WAVE2_007	1.2541	8.3772	6.221	13.155	8.460	12.900
2	65	MUN65_WAVE2_005	1.2518	7.6301	6.035	5.838	8.628	2.832
2	65F	MUN65F_WAVE2_002	1.4066	7.1758	8.333	3.599	2.672	3.291
3	25	MUN25_WAVE3_006	1.0273	7.8737	15.988	3.691	17.816	6.115
3	25F	MUN25F_WAVE3_004	1.0203	6.3143	17.611	16.939	18.376	14.902
3	65	MUN65_WAVE3_006	1.2605	7.9240	1.367	4.728	0.840	6.792
2	25	IOT25_WAVE2_002	1.2698	7.5525	5.948	2.181	7.314	1.786
2	65	IOT65_WAVE2_002	1.3195	7.5449	0.281	3.261	3.686	1.683
3	25	IOT25_WAVE3_003	1.1553	7.8600	7.264	4.150	7.576	5.930

Wave #	Direction (deg.)	Wave File Name	South West Probe H_s (m)	South West Probe Tpd (s)	% Difference from Cal Probe H_s (m)	% Difference from Cal Probe Tpd (s)	% Difference from Target H_s (m)	% Difference from Target Tpd (s)
1	25	MUN25_WAVE1_002	1.5699	8.8356	10.184	19.853	3.967	19.078
1	25F	MUN25F_WAVE1_002	1.6326	9.4460	12.283	27.578	8.119	27.305
2	25	MUN25_WAVE2_007	1.4799	8.5674	10.663	15.724	8.022	15.464
2	65	MUN65_WAVE2_005	1.2452	7.4647	6.531	3.544	9.109	0.602
2	65F	MUN65F_WAVE2_002	1.3791	9.4140	6.215	26.469	0.664	26.873
3	25	MUN25_WAVE3_006	1.1781	9.9749	3.656	31.363	5.752	34.433
3	25F	MUN25F_WAVE3_004	1.1938	6.7313	3.601	11.454	4.496	9.282
3	65	MUN65_WAVE3_006	1.2016	7.5529	3.370	0.177	3.872	1.791
2	25	IOT25_WAVE2_002	1.3140	7.4710	2.674	1.078	4.088	0.687
2	65	IOT65_WAVE2_002	1.2842	7.4860	2.402	2.455	6.263	0.889
3	25	IOT25_WAVE3_003	1.2106	7.7984	2.825	3.334	3.152	5.100

NOTE: Wave direction is relative to south wall of OEB.
H_S - significant wave height - from Zero Crossing Analysis
T_{pd} - period of spectral peak computed using 'Delft Method'
All data presented in full scale units.