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NRC NEWSLINK

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NATIONAL RESEARCH COUNCIL CANADA

SUMMER 2007

An industry ready to explode

"We in industry have a whole range of expertise that can assist police departments and other first responders around the world, but they don't know we're here." – Bob Smith, Frontline Robotics

A recent NRC test involving a laptop, a bomb and a Boeing 727 gave several Canadian companies the chance to strut their stuff. The companies design technologies to help manage disasters and high-risk security situations – everything from bomb-sniffing robots to a "disaster in a suitcase" kit that fits in the trunk of a car and can be set up within minutes to provide voice, video and data communication via satellite.

The companies participated in a first-ever Canadian event – the

deliberate detonation of a bomb inside a pressurized aircraft. On Tuesday May 8th, with safety precautions in place, an explosive was set off in the rear cargo hold of a decommissioned 727 at NRC's Uplands campus in Ottawa. The explosive was hidden in a laptop.

The event showcased multiple Canadian technologies designed to enhance situational awareness and response during an incident such as a bombing, terrorist attack or shooting. It included demonstration of technologies developed by



Frontline Robotics (Ottawa), Smart Camera Technologies (Calgary), IEG (Montréal), Anvil Technologies (North York), Terrapoint (Ottawa), Tidex Systems (Israel), Nucotech (Ottawa) and LochIsle (Ottawa).

Canada has developed many

technologies to fight crime and terrorism, but often these technologies are not well known. "We in industry have a whole range of expertise that can assist police departments and other first responders around the

world, but they don't know we're here," says Bob Smith, Defence and Security Representative for Frontline Robotics.

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TECHNOLOGY CLUSTER INITIATIVES

Water, water everywhere...



An NRC researcher and a consulting engineer attach gauges to a water pipe

Every day Canadian municipalities lose more than 150 million litres of precious water, as their distribution pipes leak and break under the strain of age and extreme weather. This is not only an environmental issue, but also a water quality concern. That is why sustainable infrastructure cluster partners in Regina, Saskatchewan, are engineering solutions for more efficient ways to supply safe water to Canadian homes and communities.

A cluster of researchers at NRC, the City of Regina, the University of Regina, and the private sector are developing technologies designed to catch leaks when they're small, understand and prevent the causes of water distribution failures, and provide water main operators with new software tools to manage these and other municipal infrastructure assets.

"As climate change becomes a reality and prolonged drought periods become more frequent, we are seeing more sewer line and water main breaks in Regina," says Dr. David Hubble, Manager of the NRC Centre for Sustainable Infrastructure Research. "The key is to catch leaks while they're small enough to plan a less expensive, proactive, repair program versus a reactive emergency program."

Regina recently experienced a historic high in water main failures – particularly in the old asbestos cement pipes that account for nearly 70 percent of its water main network. In response, NRC and its municipal and private sector partners began studying why the city's soil is moving and pipes are failing. The answers should help municipal managers across the country extend the life of water distribution systems – and save time and money. This research is expected to result in marketable decision support software tools.

Regina and Ottawa researchers, municipalities and firms are developing new ways to detect and manage leaks – by building on existing NRC technology that uses sound waves to pinpoint leaks in underground pipes. A Canadian company has already commercialized NRC's LeakFinderRT technology, and is selling it to water main asset managers around the world.

Regina's Communities of Tomorrow, a non-profit partnership between NRC, the City of Regina, University of Regina, Saskatchewan Industry and Resources, and Western Economic Diversification, is partially funding the current leak detection and management project. Beyond early detection, researchers also want to safeguard water for communities by preventing leaks entirely.

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President's outlook

Dr. Pierre Coulombe
National Research Council Canada

NRC – a focus on industry

While Canadian industries adapt and reposition to respond to increased global competition, productivity issues and converging technologies, they must also grapple with changing demographics, environmental and energy challenges.

This all points to a pressing need to develop critical competencies over the next 15 years that will address these global challenges. If Canada is to take its place among the world's leading innovators, we must make the landscape more conducive to science and technology innovation and ensure that our advances are commercially successful.

We must create conditions to leverage the skills of our valuable human resources, help companies and entire industries access distant markets, and improve our management of knowledge and resources.

To meet key global challenges, we must reduce the barriers between organizations, working collaboratively with effective, focused and determined leadership at all levels. It is becoming increasingly clear that no industry can go it alone in this economic, technological and social climate.

In this regard, NRC is moving forward to contribute to the competitiveness of

Canadian industry in key sectors – those important to Canada's economy. The sectors we have identified are R&D and knowledge intensive and rely on groundbreaking innovation to stay ahead of the competition. They are sectors where NRC can mobilize its expertise and capabilities to have the most significant impact for Canada.

More specifically, we intend to support the aerospace, automotive, electronic instruments, manufacturing and materials, engineering, construction, information and communications technologies (ICT), pharmaceuticals and biotechnology, agriculture and chemicals sectors. We will help these sectors by providing their companies with unprecedented support as they innovate and commercialize their technologies, and by expanding our stellar technology clustering efforts across Canada.

It is NRC's commitment to strengthen Canada's innovation system by increasing our capacity to transfer technology and better integrate our strengths to improve industry's power to innovate.

It is our goal to evolve NRC in a way that will create the best possible value for Canadians. ■

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Canada

An industry ready to explode

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The problem is that most of these technologies come out of small companies whose expertise is in R&D, not sales and marketing.

NRC's event gave the companies a rare opportunity to show their technologies to groups that are first on the scene during a disaster, such as the RCMP, Ottawa's fire and police services, and the Department of National Defence. Testing their technologies together allowed them to explore how their products

could be integrated to further reduce the chance of an emergency situation and to arm responders with effective tools.

"Everyone was using each other's technology to multiply their effect," says Ron Gould, the NRC Aerospace technical officer who organized this test. "It was tremendous."

The audience got a first-hand look at systems such as a helmet-mounted camera that relays live video from a disaster scene to a

remote computer, where it can be shared instantly with specialists around the world.

"That was very interesting," says Special Constable Jean Vermette with the RCMP. "For example, if we found a device that we didn't recognize [at a disaster scene], we could talk to somebody at the bomb data centre in the UK, or at the FBI, and ask them, 'Do you see what we're seeing? Do you recognize that device?'"

During the day-long event, IEG from Montréal demonstrated a speed bump that scans the license plates of cars entering a secure area and checks them against a database of approved vehicles. Terrapoint quickly created a 3-D scale model of the debris field using laser mapping technology.

"You can see the complete scene," says Vermette. "It gives you more detail than a normal digital picture, and it's a faster way to safely pass information out of the scene to the criminal investigator, who would look for suspects."

Frontline Robotics showcased a small R2D2-like robot equipped with sensors to scan for bombs in the cargo or passenger compartment of a plane.

The robots will be used to enhance security at the 2010 Olympics in Vancouver.

Frontline is an incubator company in NRC's industrial partnership facility at the Ottawa airport. According to Smith, Canadian security companies face particular challenges in the marketplace.

"It's a bit harder for a small Canadian company to be successful in this business," says Smith. He adds that the NRC connection gives his company instant credibility. "That credibility allows you to talk to the highest people in the industry. It distinguishes you head and shoulders above the rest."

Smith says NRC's history of research in security technologies has gone a long way towards building Canada's security expertise. "NRC is integral to

what's happening here, and Canada is at the forefront of a lot of this technology," says Smith. "It's been developed here, and we're proud of it."

With the test completed, NRC Aerospace will study the damaged plane to learn about the types of fractures caused by explosions as opposed to regular wear and tear – knowledge that could help in future accident investigations. "If we are ever asked to help determine whether an explosive device was involved in the loss of an aircraft, we'll now have something to refer to," says Gould.

The research fits in with NRC's larger focus on critical issues facing the aerospace sector, in areas including manufacturing, gas turbine engines, aerodynamics, flight research, and aircraft structures and materials. ■

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A 3D future for Canadian industry advantage

NRC has licensed its 3D technologies to nine Canadian firms, which have injected an estimated \$50 million annually into the Canadian economy and created more than 300 jobs. The full potential of these technologies is only starting to be felt.

In late 2006, media around the world broadcast surprising information about Leonardo da Vinci's world famous *Mona Lisa* portrait. For the first time, unseen details within layers of the painting were visible through the remarkable 3D scanning technologies developed by NRC.

But this wasn't the first time that NRC's 3D technologies have made headlines. For more than ten years, NRC has enjoyed a well-earned reputation as the world's top heritage imaging resource. The *Mona Lisa* project was just a recent chapter in a growing catalogue of successes that began in the late 1980s for the Visual Information Technology Group, part of the Ottawa-based NRC Institute for Information Technology.

Beyond helping curators and conservators who are studying masterpieces in Europe, China, Israel, Canada and the United States, NRC's 3D technologies are also being used by several Canadian companies in the manufacturing, space, forensic and entertainment sectors.

"NRC's strategy is to help Canadian firms use our 3D technologies to increase their competitive edge, especially in the automotive and aerospace sectors," says François Blais, who leads the NRC Visual Information Technology Group. "The industrial opportunities are endless."

Handling jobs such as quality assurance and in-line inspections for the automotive industry is a natural fit for 3D technologies where manufacturers depend on zero-defect shipments.

"Imagine how efficient the industry could be if it used the latest 3D hardware

and software to inspect parts and correct errors to within a few microns during production," Blais adds. "There's no doubt about it – 3D is the way to go!"

Since spinning out from NRC in 1994 with licences for several NRC technologies, Innovmetric has become a world-leader in 3D modeling for the automotive and aerospace sectors. The company has supplied 3D software solutions to industry giants such as Honda, Toyota, Ford, GM, Rolls Royce, NASA, Airbus and Boeing.

Millions of people around the world have seen the magic of these technologies in the movies. XYZ RGB Inc., another NRC licensee, produced spectacular 3D effects in the *Lord of the Rings*, *King Kong* and the *Matrix* sequels, garnering recognition when it was short-listed for an Academy Award for technical accomplishment.

"The organizations that have benefited from our 3D technologies and expertise have provided the impetus for ongoing R&D," says Blais. "Every new potential application is an opportunity to adapt our technologies for other high-value uses."

One of the most astonishing parts of this story is the pace of progress in this field, adds Blais. "It took well over 100 years for the first primitive film camera to evolve into the mass-marketed digital camera of the early 1990s," he says. "Things have moved much faster in 3D. In 15 to 20 years, I expect that 3D technologies will be mass-marketed for use in more applications than we can possibly imagine today."

To learn more about NRC's 3D technologies program, visit: iit-iti.nrc-cnrc.gc.ca/about-sujet/vit-tiv_e.html ■

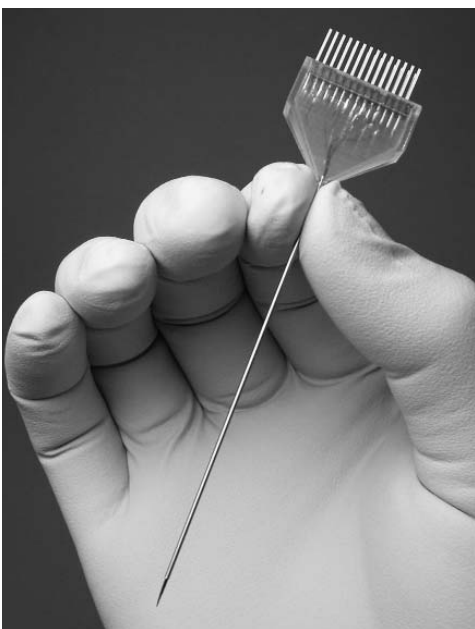


Atelier 3D is NRC's newest software toolset for analyzing complex objects such as the Mona Lisa

Laser camera manufacturers and scanning service bureaus have licensed and adapted different aspects of NRC technologies for their own applications:

- Neptec Design Group built a laser camera system to inspect the thermal-protection tiles of space shuttles before their re-entry.
- ShapeGrabber Inc. developed an automated 3D inspection station.
- Arius3D Inc. developed its own colour laser scanner.
- Optech Inc. combined NRC's colour projection algorithms with its long-range laser scanner for civil engineering applications.
- GIE Technologies from Montréal uses NRC technology for road inspections.
- ShapeQuest Inc. has licensed NRC's ShapeCapture software for use in 3D measurement and modeling applications.

New technology to ease Parkinson's



Deep brain stimulation multi-channel device

Scientists at NRC and a London, Ontario research institute have developed a medical device to help treat people with neurological disorders such as Parkinson's disease. The new technology is already generating awards and recog-

"... I have always dreamed that someday we will be able to rewire the brain to treat devastating diseases. NRC's contribution to the medical device industry, and its role in guiding and enhancing the development of Medtronic, have been a key part of our progress toward achieving that goal."

Medtronic CEO Souhile Assaf

ognition for Medtronic, a London company that has licensed it.

The technology, a small implantable device that can simultaneously stimulate parts of the brain and record neuron signals, is designed to support a procedure called deep brain stimulation (DBS) – the leading treatment for advanced cases of movement disorders. DBS also shows promise for treating diseases such as Tourette's syndrome as well as severe chronic pain, which is often associated with spinal cord injuries.

The device was developed by Dr. Suwas Nikumb, a researcher with the NRC Integrated Manufacturing Tech-

nologies Institute, and his colleague Craig Dinkel, in collaboration with Dr. Mandar Jog, a scientist at the Lawson Health Research Institute who is also a neurologist at the London Health Sciences Centre.

"The expertise in manufacturing science that exists at NRC has resulted in a DBS device that has more channels and functions, and is smaller than current electrodes," says Dr. Nikumb. "This is a huge advance on current technology."

"As a neurophysiologist, I have always dreamed that someday we will be able to rewire the brain to treat devastating diseases," says Medtronic CEO Dr. Souhile

Assaf. "NRC's contribution to the medical device industry and its role in guiding and enhancing the development of Medtronic have been a key part of our progress toward achieving that goal."

In September 2006, the Neurotech Leaders Forum – held in San Francisco – awarded Medtronic the prestigious "2006 Gold Electrode Award" as the most promising start-up firm in the international neurotechnology industry. And in March 2007, Medtronic was a finalist for a Business Achievement award from the London Chamber of Commerce in the area of product innovation.

The DBS multi-channel device was developed with funding from the Canadian Institutes of Health Research, the Ontario Centre of Excellence for Materials and Manufacturing, and the Health Technology Exchange. Support from the NRC Industrial Research Assistance Program (NRC-IRAP) will enable extended testing and allow Medtronic to further advance the development of the device.

For more information: www.nrc-cnrc.gc.ca/highlights/2005/0501_neuroprobe_e.html ■



Technology for cleaner air – While in Vancouver to deliver an environment-related announcement, Prime Minister Stephen Harper and B.C. Premier Gordon Campbell watched John Tak, President and CEO, Hydrogen & Fuel Cells Canada, and John Sheridan, President and CEO, Ballard Power Systems, demonstrate alternative fuel technologies at NRC's research facility.

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12th International Congress on the Chemistry of Cement, July 8-13, 2007 in Montréal, Quebec
 ICC 2007 will share leading-edge scientific information and knowledge on innovative technologies and processes of interest to the cement science and manufacturing communities.
 For details: www.iccc2007.org

Nutrisciences and Health 2007: Bioprospecting for Neuroprotectants, July 10-12, 2007 in Charlottetown, Prince Edward Island
 This conference will explore the neuroscience implications of naturally occurring bioactives. Experts will present on topics such as neurodegeneration, bioprospecting, genomics and nutrition, and product development.
 For details: nsh2007-sns2007.nrc-cnrc.gc.ca/main_e.html

Atlantic Privacy and Security Summit 2007, July 30, 2007 in Moncton, New Brunswick
 The Summit will cover challenges and opportunities relating to security and privacy issues in a borderless world. Identity theft, viruses, privacy compliance and online financial fraud are among many top-level business and government concerns to be addressed at the Summit by expert panelists and prominent keynote speakers, including Dr. Jonathan Cave (RAND Europe).
 For details: www.unb.ca/pstnet/itrust-pst2007/AtlanticSummit2007.htm

MetFoam 2007 Conference on Porous Metals and Metallic Foams, September 5-7, 2007 in Montréal, Quebec
 Metallic foams, relatively new materials with a wide range of applications, can be used to manufacture lightweight structures, filters, heat exchangers, sound absorbers, mechanical damping devices, electrodes, charge carriers, sensors, catalyst supports and biomedical implants, to name a few. Interest in these materials has risen over the last few years, and both new materials and applications are created every year.
 For details: www.reseaumateriauxquebec.ca/met-foam2007/index.htm

Water, water everywhere...

Continued from page 1

“NRC’s technology cluster initiatives are encouraging research partnerships between federal, provincial and municipal governments, industry, and the higher-education sector... accelerating the commercialization of new technologies...[and] building regional S&T capacity in key sectors and industries across Canada.”

Canada’s Science & Technology Strategy: Mobilizing Science and Technology to Canada’s Advantage
 Government of Canada, May 2007

Their research goals include developing non-destructive test methods and robotic devices to inspect pipes, as well as identifying ways to manage conditions to avoid future problems.

Work with industry partners also covers technology solutions for addressing water quality problems in distribution systems, developing online monitoring tools, and investigating storm water management under adverse conditions – including climate changes. Once new tools have been validated and demonstrated in a real municipal setting such as Regina as the living lab, they will be commercialized and used by consulting firms and municipalities throughout Canada and abroad.

In North America, the estimated replacement costs for municipal infrastructure ranges from \$2 billion to \$23 billion annually. It’s clear that municipalities everywhere need better tools to sustain their vital community lifelines. Most experts agree that the work done by Regina’s sustainable infrastructure cluster will have national and international implications, and that there has never been a more critical time for these kinds of R&D partnerships. ■

NRC spin-offs a good bet

“Many of our spin-off companies are well on their way to sustainability... when companies earn \$160,000 per employee, they’re not eating capital anymore.”

Despite weathering a high-tech slump and a lengthy downturn in venture capital markets, NRC spin-off companies are proving they’re here to stay. Over the past five years, dozens of new firms created from NRC science and technology have continued to attract investment while adding to the bottom line of the Canadian economy.

Last year, 35 NRC spin-offs combined to earn over \$96 million in revenue – a healthy \$160,000 per employee – up 29 percent from about \$75 million in 2005, according to an annual survey of NRC spin-offs.

“This shows that many of our spin-off companies are well on their way to sustainability,” says Clement Langemeyer of NRC. “In 2002, the average revenue per employee was only \$43,000, which means that NRC spin-offs were living off borrowed money. But when companies earn \$160,000 per employee, they’re not eating capital anymore. That’s a very encouraging number,” he stresses.



NRC has a long track record of fostering new companies. Since 1995, NRC has stimulated the creation of over 60 Canadian firms, spanning more than a dozen industrial sectors such as biotechnology, health care, computer software, advanced manufacturing, communications, elec-

tronics and information technology.

The 2007 survey – entitled “Economic Impact of National Research Council Canada Spin-Off Companies – involved 35 NRC spin-offs, most of which have been tracked each year since 2003. They included 24 Ontario firms, five from Atlantic Canada, four from Western Canada, and two from Quebec. The survey, conducted by Guelph, Ontario-based Adventus Research, covered a 12-month period ending in December 2006.

According to the survey, in 2006, export revenues rose sharply from \$64 million to \$85 million – or 88 percent of total revenues. “That’s gold, because it represents money flowing into Canada from abroad,” says Langemeyer.

In 2006, total full-time employment decreased 13 percent from 698 to 604, due to downsizing at several companies and the disappearance of another. Despite the drop in employment, 2006 was on the whole a good year for NRC spin-offs, which attracted \$63 million in new investment – an average of \$1.8 million per firm. The biggest deals reported included one worth \$22 million and two that raised \$12 million. Overall, NRC spin-offs have collectively raised more than \$400 million in investment since the beginning of 2002, notes Langemeyer.

“Companies like SiGe Semiconductor are doing extremely well,” Langemeyer says. “SiGe shipped its 150 millionth chip in the first quarter of 2007.” Other companies to watch are Novadaq Technologies, IMRIS and Zelos Therapeutics – a biotechnology firm that is sure to attract the attention of the large pharmaceutical multinationals,” he concludes. ■

Enviroclub: Green manufacturing makes \$ense

It takes more than mounting public concern to bring about the greening of Canada’s manufacturers. That’s why, seven years ago, NRC threw its weight behind Enviroclub – a Quebec-based initiative that has already helped more than 168 manufacturers increase their profits while voluntarily cleaning up their production processes.

Through a unique partnership, Environment Canada, Développement économique Canada pour les régions du Québec (DEC) and NRC are successfully engaging Quebec-based manufacturers in the Enviroclub initiative, helping them learn how a better environmental performance is good for business.

From 2000 to June 2007, 22 Enviroclubs were launched – each comprising about 15 participating companies. They include manufacturers of commodities ranging from hydroponic tomatoes to lumber, clothing, kitchen cabinetry, packaging materials, aluminium tubing, cleaning products and more. Almost all the participants have seen their profits rise.

To be eligible, companies must conduct a project to reduce or eliminate their use of toxic substances; use less energy, raw materials and water; or reuse or recycle materials. They must also learn how to apply a system to better manage the environmental impacts of their activities.

“Through Enviroclub, NRC is helping companies *learn by doing*,” explains Denis Morrissette, a technology advisor for the NRC Industrial Research Assistance Program (NRC-IRAP) in Quebec. “And, because the participants share their project experience with others facing similar challenges, they all benefit from the lessons learned.”



Jean-François Rivest, President of Voodoo Technologies

Before Enviroclub was launched, Environment Canada had no effective means of persuading companies to voluntarily re-engineer their processes, says Morrissette. Companies needed financial

Supported by NRC, Enviroclub has helped Quebec-based industry recognize that better environmental performance means greater market access and bigger profits.

support and expert help. When DEC – the federal agency responsible for economic development in Quebec – and NRC contributed expertise and money, the program came together. NRC-IRAP also knew the language that small companies would respond to: greater profits and new markets through better environmental performance.

From 2000 to 2005, NRC-IRAP contributed \$5,000 toward each participating company’s project for a total of \$150,000 each year. The money helped pay the consultants engaged to help the companies develop and conduct their eco-efficiency projects. In addition, NRC-IRAP advisors in Quebec referred companies to Enviroclub, focusing on those with the most to gain from re-engineering their processes.

Morrissette notes that, in just a few short years, the program has produced enviable results. “Spectube, a manufacturer of aluminium tubing in Chicoutimi, is now saving \$59,000 and using 68 percent less trichloroethylene each year. That’s 35 tonnes less solvent discharged annually into the atmosphere.”

And that’s only one small success, he adds. Voodoo Technologies, Canada’s largest manufacturer of rotomoulded kayaks, now saves \$115,000 annually because it changed certain processes that reduced its gas consumption by 22,300 cubic metres and its waste by 35 percent. Thanks to Enviroclub, Industrie ILI ben-

efited from a solvent chemistry expert who helped the company replace two toxic chemicals in its cleaning and maintenance products. The company can now respond to the market demand for “green” products.

Enviroclub participants spend only eight to ten months in the program, reporting a return on investment – on average – within two years. In the process they become leaders, among the first in Quebec to voluntarily reduce their own environmental footprint.

To read case studies and view videos on re-engineered production processes, visit www.enviroclub.ca ■

An Enviroclub is a group of companies from a given region or sector that receives expertise and funding to:

- conduct an in-plant pollution prevention project that reduces production costs; and
- improve their knowledge of environmental performance through workshops and a network of professional contacts.

Helping start-ups succeed

Life can be tough for new businesses: in Canada, two out of three firms fail before their fifth anniversary. And for small firms trying to bring an innovative technology to market, the going is even tougher. But NRC's "industry partnership facilities" (IPFs) can help.

"A poor survival rate is one reason why NRC works hard at improving the odds for Canada's smaller technology driven start-ups," says Jean-Jacques Ledoux, manager of an NRC IPF in Ottawa. "NRC's top concern is to help Canadian start-ups commercialize the technologies that come out of our own research institutes. We want Canadians to benefit from the jobs, products and services these companies will generate."

Ledoux sees all the challenges young technology companies face. And he knows what they need to survive the early years when they generate little or no revenue. "Feasibility and market studies, business advice, planning and access to funding are some of the first concerns," he comments. "Start-ups also need to work in secure facilities with phone, fax and computer networks, expensive equipment and technical support, but they don't have the money to set up by themselves." For a reasonable fee, NRC offers young qualifying companies these services and continuous access to some of Canada's top researchers whose labs are just down the hall.

NRC is selective about the companies it supports. "To qualify, the business must be able to benefit strongly from NRC expertise," says Ledoux. "It must also show a convincing business plan with market analysis, sales projections, funding requirements and management background. In addition, the business must have a strong potential to expand and create jobs in Canada."

Since Ledoux's Ottawa-based IPF started in 1998, 17 firms have "graduated." Several of them have seen remarkable suc-



Iridian staff at work in an Ottawa-based NRC industry partnership facility

cess, and all but two are still in business after five years.

Zelos Therapeutics has been very successful in attracting capital and marketing Ostabolin-C™, an injectable drug designed to fight osteoporosis. Its parathyroid hormone-based products evolved from work that originated in NRC.

XYZ RGB Inc., a licensee of NRC 3D imaging technologies, produced spectacular cinematic effects in the *Lord of the Rings*, *King Kong* and the *Matrix* sequels, garnering considerable recognition for its technical accomplishments. Arius3D Inc. also began inside the fold, as did Ionalytics Corporation, Luzchem Research and SiGe Semiconductor – all doing well in today's marketplace.

Dr. Derek Houghton is a former NRC researcher who co-founded SiGe Microsystems (now SiGe Semiconductor), an NRC spin-off that started out with advanced silicon ger-

manium process technology and evolved to develop radio frequency and mixed-signal integrated circuits for next-generation broadband cable and wireless devices. SiGe Semiconductor now has more than 100 employees worldwide and, in 2006, its revenues exceeded \$50 million. Houghton recalls the tough early years of the company. "We couldn't have made it without NRC," he readily admits. "The help we received was essential to sustain our competitive advantage in the global market."

Despite his continuing involvement with silicon germanium technology, Dr. Houghton has also invested in Quebec-based Sixtron Advanced Materials, a small firm launched in 2003 for which he serves as chief commercial officer. Sixtron has a lot of R&D ahead to meet the ever-increasing demands of its customers.

Dr. Houghton recently dropped in on Ledoux to talk about bringing Sixtron into the IPF where SiGe had offices in its earliest days. He wants the company to benefit from NRC expertise as it develops special coatings that will increase the efficiency of solar panels. Dr. Houghton knows how big the market could be, and wants NRC's support to help the company capture it. ■

10: Provinces with NRC IPFs
15: Number of IPFs at NRC
100+: Number of firms currently housed in NRC IPFs
29,989 m²: NRC's national total for IPF space. Canadian firms benefit from full-service facilities (proximity to vibrant technology clusters; access to R&D expertise; design, testing and prototyping services; technical information and business planning services; and opportunities for research collaborations and networking).

Have a young company that needs a great home?
 For locations and more details, visit: www.nrc-cnrc.gc.ca/doingbusiness/colocating_e.html

SCIENCE OUTREACH

Wanted: Home on Red Planet

"Hey Martians! How are you? We are creating a water supply system and we might be making a pump because scientists think that Mars could have water only three feet below the surface. The only thing we cannot do is bring water to Mars. If we did, it would be too heavy."

Marsville blog entry



Science mentors quiz students on their model survival systems

NRC's Science Outreach program aims to make science exciting and inspire youth to pursue careers in science and technology in recognition of the need to enhance the supply of highly qualified professionals in Canada.

Students across Canada were challenged to survive on the Red Planet during this year's Canadian National Marsville – an NRC-led science outreach program that invites students from grades six to eight to plan the first human habitation on Mars.

More than 2,100 students participated in locations across Canada, including Ottawa, Toronto, Winnipeg, Vancouver, Victoria and Whitehorse. They spent three months researching space travel and the Martian environment, then built model survival systems to meet human needs such as food, energy and transportation. Finally, on April 20th – "Link-

up Day" – students in each region came together to showcase their survival systems and build a simulated Martian community of inflatable plastic pods.

This year, Canadian astronaut Julie Payette made a live appearance in Whitehorse, where she talked to students about space travel.

In 2006, NRC took over leadership of the national Marsville program, creating a student friendly Web site as well as a Marsville Blog. "Our students were on [the blog] regularly – reading, writing and communicating with kids across Canada," says Ottawa teacher Richard Simpson. "It was awesome – a great opportunity for the kids." ■

What's this?

A "hull" of an advantage

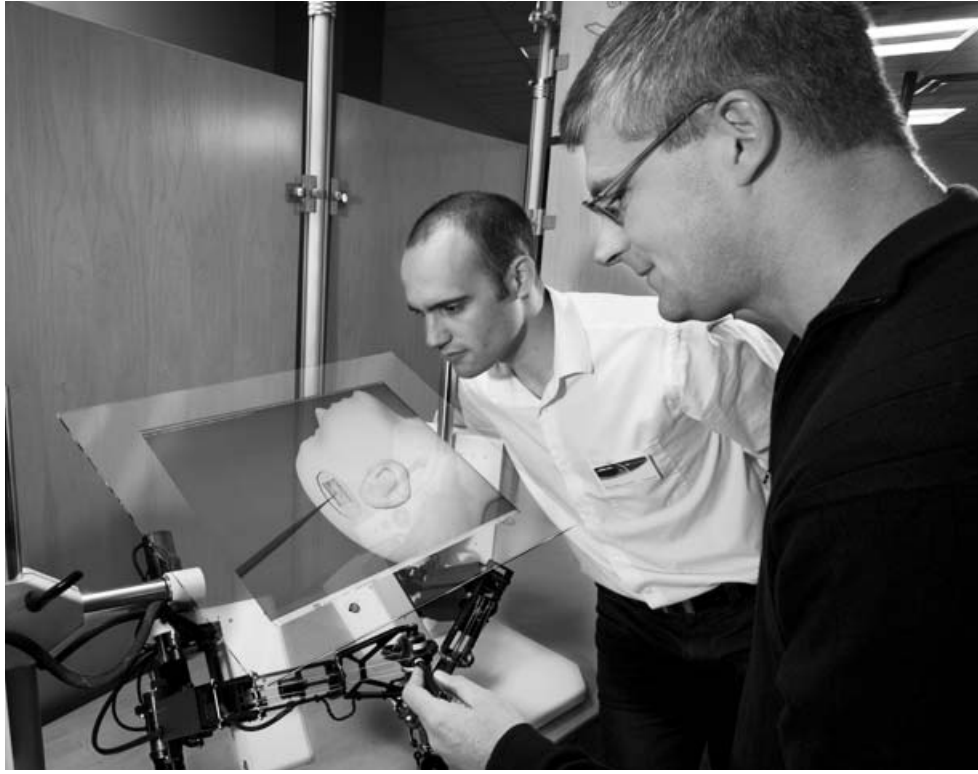


This is a view of the underside of two boat hull models. An NRC spin-off and commercial partner, Oceanic Consulting Corporation, has once again evaluated hull designs for world-class racing yachts – this time for the 32nd America's Cup in Valencia, Spain.



Teams from the United States and two European countries had their yacht designs tested by Oceanic using NRC facilities and expertise in St. John's, Newfoundland. Oceanic has built its reputation by working on previous America's Cup yachts for Australian, American and Swiss teams, including Team Alinghi, winner of the 2003 Cup. Due to this sport's high competitive stakes, the actual America's Cup hulls cannot be shown, so the top photo depicts other hulls engineered and tested at NRC. ■

Virtual surgery: Real-life impact?



Dr. Yves Starreveld, a surgeon at Calgary's Foothills Hospital (foreground) tests NRC's neurosurgical haptic system with researcher Vincent Mora.

Healthcare systems are stretched, so technologies that can save precious hospital time, improve surgical procedures and better equip future surgeons are certainly welcome.

World-renowned experts recently gathered at NRC in Boucherville, Quebec, to discuss new ways that technology can do just that. Representatives from industry, universities and government joined medical professionals to discuss 3D simulation, computer-assisted surgery and other up-and-coming medical technologies at the Computer Simulation in Medicine (CompMed) Symposium.

"The symposium comes at a time when three-quarters of cancer tumours are treated by surgery and further to that the medical profession is quickly moving towards less-invasive surgical techniques," says

Dr. Robert DiRaddo of the NRC Industrial Materials Institute. The good news is that these new less invasive surgical methods help reduce hospital stays. The flip side is that these constantly evolving techniques also take time and effort for the surgeon to continuously learn.

Surgeons-in-training currently learn by assisting and performing hundreds of operations under the guidance of experienced surgeons. "Assisted surgeries often can take twice as long, and these surgical techniques can be so complex that surgeons don't have the opportunity to train other surgeons," Dr. DiRaddo says. As leading specialists and experienced surgeons prepare to retire, there are challenges regarding passing on the required expertise. That's where surgical simulation comes in: surgeons-in-training can re-

hearse complex surgical procedures without tying up costly operating room time.

Using software under development at NRC, surgeons-in-training will rehearse delicate brain surgery – before having to participate in real operations. The software creates a 3D "virtual neurosurgery" that both looks and *feels* as though the student is operating on a real patient. Users receive haptic – or touch – feedback, pressure as though they are actually cutting into flesh with a scalpel or scissors, describes Dr. DiRaddo. "NRC's haptic system, which is developed jointly with Montréal-based MPB Communications, has seven degrees of freedom of motion. It's unique in the world," he adds.

"Surgeons could soon be required to train with 'virtual surgeries' before operating on real patients...the same way pilots train on flight simulators before flying a plane."

Dr. Robert DiRaddo, NRC

Beyond teaching medical students neurosurgical skills, the innovative training system would also allow more experienced surgeons to keep up with newer surgical techniques and developments, and could possibly provide hands-on instruction for surgeons working in remote communities.

From soda bottles to brain surgery

The project is an excellent illustration of how NRC leverages existing expertise into new opportunities. The neurosurgery software evolved from NRC's existing angioplasty simulator that is currently being evaluated by a Toronto-area surgeon and will soon be transferred to industry.

"The first software we developed was to predict the fabrication of soda bottles and peanut butter jars," Dr. DiRaddo recalls.

Experts rendez-vous at NRC

The CompMed Symposium, co-supported by the international Society for Simulation in Healthcare, attracted top surgical simulation experts and representatives from North America, Europe and Asia. Phillip Hassen, CEO of the Canadian Patient Safety Institute, opened the Symposium and guest speakers included Drs. Steve Dawson (Harvard Medical School), Gerald Fried (McGill University), Richard Reznick (University of Toronto) and Ken Cavanaugh (FDA).

Since its development in the mid-1990s, the technology has primarily been used by the automotive sector to design better and environmentally friendly parts. Adding the biomedical sector to the mix began five years ago – and not a moment too soon. "My NRC colleagues in Calgary and Winnipeg, Mike Sowa and Boguslaw Tomanek, helped us tremendously in this transition," Dr. DiRaddo says.

"Surgeons could soon be required to train with "virtual surgeries" before operating on real patients," says Dr. DiRaddo. "The same way pilots train on flight simulators before flying a plane." In the United States, the Food and Drug Administration (FDA) recommended the use of virtual reality technology for surgeons training on carotid stenting.

"Strengthening Canada's position in this important and emerging field of surgical simulation is critical," he says, stressing the national, collaborative nature of this research. "It is an incredibly multidisciplinary field requiring surgeons, engineers, biologists, educators and computer programmers – who all have to work together."

Held May 16-18th, CompMed crossed borders to connect experts who are committed to making surgical procedures more accurate, efficient and innovative than ever before – improving success rates and potentially saving lives near and far.

The surgeries may be virtual, but the impact could be very real. ■

"Kryptonite" confirmed: Superman beware!

"Finding out that the chemical composition of a material submitted for review is an exact match to an invented formula for the fictitious kryptonite – this was the coincidence of a lifetime." – Dr. Yvon Le Page, NRC

Superman's nemesis, kryptonite, is no longer the stuff of fiction. A new mineral matching its unique chemistry – as described in the film *Superman Returns* – has been identified by scientists at NRC and the British Natural History Museum.

In Superman stories, exposure to kryptonite's large green crystals causes the superhero to weaken. But unlike the fictional rock, the new mineral is white, powdery and not radioactive. And rather than hailing from outer space, the real kryptonite was found in Serbia by the mining firm Rio Tinto. Unable to determine what it was, Rio Tinto sought help from Dr. Chris Stanley, a mineralogist at the Natural History Museum.

Dr. Stanley measured the mystery material's chemical and optical proper-

ties. But in order to officially classify a new mineral, its crystal structure must also be determined. The sample's crystals were too small for traditional analytical methods. So the British scientist enlisted the expertise of NRC researchers Drs. Pamela Whitfield and Yvon Le Page to analyze and validate the mineral's crystal structure.

Using state-of-the-art equipment, the NRC team concluded that the mineral was, as Dr. Stanley had suspected, a "new borosilicate material" worthy of being documented by the *European Journal of Mineralogy*. Later, when he searched the Web for the mineral's chemical formula – sodium lithium boron silicate hydroxide – Dr. Stanley was amazed to discover the same scientific name written on a

case of rock containing kryptonite, which was stolen by arch-villain Lex Luthor in *Superman Returns*. Although the new mineral contains no fluorine, in all other respects its chemistry matches the fictional kryptonite.

"Finding out that the chemical composition of a material submitted for review is an exact match to an invented formula for the fictitious kryptonite – this was the coincidence of a lifetime," says Dr. Le Page.

Approximately 30-40 new minerals are discovered each year. Each must be registered with the International Mineralogical Association's Commission on New Minerals, Nomenclature and Classification, which determines if a new mineral is genuinely unique. ■



The name kryptonite is unlikely to stick when the new mineral (shown above) receives its official name later this year. Scientists from Natural Resources Canada, the Geological Survey of Canada, and the Canadian Museum of Nature have collaborated to ensure the new mineral is recognized by the international scientific community.

Industry hungry for neutrons

At the dawn of the nuclear age, NRC scientists envisioned an R&D tool that could tap into the enormous potential of nuclear energy. This year, the National Research Universal (NRU) reactor in Chalk River, Ontario, celebrates 50 years of achievements – including a Nobel Prize – while continuing to fuel advances in everything from green energy to advanced materials to cancer treatment.

Built in 1957, NRU was designed as a multipurpose research facility rather than to generate steam or electricity. Canada's \$5 billion nuclear energy industry was built on the fundamental knowledge gathered in the test facilities at NRU, which today is owned and operated by NRC's largest spin-off, Atomic Energy of Canada Limited (AECL). The facility continues to test nuclear fuels and materials for the fleet of CANDU nuclear power stations that supply one-sixth of Canada's electricity and employ 30,000 Canadians.

"For well over 40 years, the test facilities inside NRU have allowed the industry to constantly improve the safety and performance of its technology," says Robert Speranzini, General Manager of CANDU Technology Development at AECL. "That has brought benefits to all Canadians – in domestic electricity free from greenhouse gases, and in international trade worth billions of dollars."

NRU is also an important research tool for understanding the true nature of matter. The neutrons produced in the reactor can penetrate deep within materials – from steel to concrete to ice – to reveal their structure at the atomic scale. This technique – called neutron scattering – helps industry to answer questions that can't be addressed in any other way.

"For example, using neutron scattering, you can look at a particular point within a car engine to see whether it's experiencing strain or not," says Ian Anderson, director of neutron science at the Spallation Neutron Source in Oak Ridge, Tennessee. "No other technique can do that – not X-rays, not anything."

NRC researcher Dr. Bertram Brockhouse won a Nobel Prize for his pioneering work in neutron scattering at NRU. Today, those same principles are used by NRC's research presence at the facility – the Canadian Neutron Beam Centre (NRC-CNBC) – to help industry develop safer and stronger components for applications such as railroad tracks, car engines and aircraft. NRC-CNBC's presence at NRU attracts academic and industrial clients from around the world, all of whom are welcome to use the facility. "This open approach creates opportunities for Canadian researchers to use facilities in other countries," says Anderson. "It really helps scientific exchange."

Today, NRU is a vibrant facility that remains world class a half century after its construction. Canada's investment has reaped dividends in launching new industries, enabling groundbreaking research, and producing medical products that touch the lives of millions of people in 80 countries around the world. ■



NRC scientist Dr. Ron Rogge explains to post-doctoral researcher Roxana Hutanu how, as part of the Challenger accident investigation, neutrons were used to measure the stress inside this component from NASA's space shuttle.

Cancer treatment for millions: one of the earliest innovations from NRC's work at Chalk River was nuclear medicine, and today, Canada has the largest medical isotope industry in the world. More than 16 million people in 80 countries are treated for cancer each year using medical isotopes produced at NRU, and another 5 million are diagnosed with CT scans and other techniques.

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Recognized globally for research and innovation, NRC is a leader in the development of an innovative, knowledge-based economy for Canada through science and technology. NRC operates world-class research facilities as well as information, technology and innovation support networks coast to coast. Its outstanding people help turn ideas and knowledge into new products, processes and services, creating value for Canada. NRC works hand-in-hand with partners from industry, government and universities to help ignite the spark of innovation in communities across the land and to give Canadian companies a competitive edge in today's marketplace.

International connections

This spring, NRC hosted international visits from Chile, Spain, France, China, the United States and Brazil, as well as a 42-member delegation of ambassadors representing numerous countries.

On June 4, 2007, NRC signed a memorandum of understanding with the Helmholtz Association of German Research Centres. Both organizations pledged to work together for the next three years to help Canada and Germany achieve results in clean energy. This pact will bring together some of the world's best researchers in the fields of alternative energy, bio-fuels and environmentally friendly uses of energy to help lower greenhouse gas emissions and reduce pollution.

Clean energy and environmental technologies were also among the key research areas confirmed during the inaugural Canada-China Joint Committee meeting. The Committee oversees a January 2007 S&T agreement that connects Canadian and Chinese researchers to accelerate col-

laboration, scientific discovery and commercial applications in areas that will have great social and economic benefits for both countries. During its first meeting on May 28, 2007, five expert working groups were identified, and the following research areas were also confirmed: health and life sciences; and biotechnology, agri-foods and bioproducts. Plus the Committee recognized the importance of collaboration in nanotechnology, and information and communication technologies (ICT), including photonics.

As co-chair of the Canada-China Joint Committee, NRC President Dr. Pierre Coulombe welcomed the Chinese delegation led by Vice Minister Shang Yong of the Chinese Ministry of Science and Technology. Canadian committee mem-



From left to right: Ambassador Eugenio Ortega from the Embassy of Chile in Canada, NRC President Dr. Pierre Coulombe, and Chilean Minister of Economy Alejandro Ferreiro.

bers include representatives from the private sector (David Hudson, VP Portfolio Management, Chief Technology Office, Nortel Networks); academia (Luc Vinet, Rector, University of Montréal); and the public sector (Margaret McCuaig-

Johnston, Assistant Deputy Minister, CCRS-NRCan; Paul Thoppil, Director General, DFAIT and the Committee's Canadian Secretary). ■