A Machine-Vision Based Radiotherapy Gating Device

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A Machine-Vision Based Radiotherapy Gating Device

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Patient respiration during radiotherapy can cause significant motion of the tumour volume, which can be mitigated by gating the accelerator beam to patient respiration. This work describes a machine-vision respiratory-gating system, based on our reported photogrammetric patient position measurement technique[1]. The system comprises two CCD cameras permanently mounted approximately two meters from the linac or simulator isocentre. Inherent contrast of retro-reflective markers on the patient's skin is obtained by infrared illumination combined with infrared filters on the cameras. Emphasis on image processing (automatic positional calibration, corrections for radial and decentering lens distortion, and image deformation) allows absolute marker positions to be reported in the linac (IEC) frame of reference with an accuracy of +/- 0.5 mm, a precision of 0.2 mm and a temporal resolution of less than 150 ms. Hence, the system is simultaneously capable of monitoring mean patient position and real-time variations due to motion and respiration. Digital capture of fluoroscopy video is time-synchronized to the vector position of the reflective markers with respect to the isocentre, and the clinically relevant parameter of motion in the beam's eye view is used to set gating thresholds. With this approach, we have demonstrated under fluoroscopy that respiratory motion can be reduced from more than 2 cm to less than 2 mm. Experimental details and system performance will be reviewed, and new applications discussed.

[1] LH Gerig, et al. "The Development and Clinical Application of a Patient Position Monitoring System." Videometrics III. Proc. SPIE 2350, Nov. 1994.