AbstractID: 1621 Title: Geometric cross-calibration of an integrated cone-beam imaging and treatment unit

The development of volumetric imaging systems for the purpose of guiding radiation therapy has been a major interest of research in radiation therapy. Medical linear accelerators with kilo-voltage (kV) imaging and Mega-voltage (MV) treatment system offer a highly promising platform for high-precision, image-guided radiation therapy. Geometric calibration is essential for accurate radiographic guidance, cone beam CT reconstruction and dose delivery. A calibration phantom and method for the estimation of the geometric parameters of the kV imaging system and MV delivery system has been developed, tested, and employed on a clinical image-guided radiotherapy unit. The sensitivity and accuracy of the method has been shown to be excellent with an uncertainty of 0.02^{o} and 0.1mm. The method is used for complete calibration of a medical linear accelerator including kV/MV source position, imaging device position/rotations, couch motion, and mechanical axis of collimator as a function of gantry angle. The focal spot was found to lie within 0.9mm of the collimator axis of rotation (AOR), at 1002.3mm from the AOR of the gantry and underwent displacement of <0.5mm during 200MU of beam delivery. Since this method is highly automated and integrated, acceptance testing, annual and monthly machine QA for precision radiation therapy such as stereotatic, IMRT, and CBCT on linear accelerator can be done accurately and quickly. The results demonstrate the reproducibility of these systems and provide opportunity for quantitative evaluation of the geometrical/mechanical performance of these complex systems.

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