Automated Image Based Quality Assurance for Medical Linear Accelerators

Regular quality assurance measurements recommended by the AAPM TG-40 are an important component of the radiation oncology department's overall quality assurance program. The increased availability of dual photon beam multi-modality treatment units creates a time consuming and exacting task for the medical physicist who performs these measurements.

We have developed an innovative system for computerized image based quality assurance (IBQA) composed of a software program with a corresponding imaging phantom. The phantom is designed for use with radiographic film or EPID and contains a unique set of markers, which establish the coordinate system, x-y magnification factors and the positions of the localizing light-field edges. The IBQA system is capable of automatically determining the required radiation beam QA parameters such as field-symmetry, field-flatness, field-width, field-length, penumbra-width, field-edge orthogonality, as well as the congruence of light-localizer/radiation-field and cross-hair centricity. The software is user friendly, based on client-server technology, and is integrated with a database with report writing functionality.

The image processing and registration algorithms used by IBQA software automatically detect fiducial markers, adjust x-y magnifications, correct for image warping and rotations, use fitting and smoothing techniques to improve SNR and rapidly computes all field parameters for QA analysis. The IBQA system was tested with a set of images created under range of accelerator field conditions. It successfully determined beam uniformity, field-size and light/radiation-field coincidence within $\pm$0.5%, $\pm$0.25 mm and $\pm$0.25 mm respectively.

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