# DAILY MLC PERFORMANCE EVALUATION USING A HIGH-RESOLUTION PORTABLE FLAT PANEL IMAGER

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With the release of the Incise Multileaf Collimator, the CyberKnife system provides the means for the delivery of more-efficient, and in some cases, more-conformal treatment plans. This technology necessitates the inclusion of MLC performance evaluation into a clinic's regular quality assurance program. Presented is a method of MLC performance analysis using the QA StereoChecker (QASC, Standard Imaging Inc., Middleton, WI), a portable high-resolution amorphous silicon flat-panel imager.

A notable feature of this device is a coupled set a fiducial markers, which allows the device to be automatically aligned using the CK's target localization system (TLS). Through the use of the TLS, physicists and therapists can perform daily QA using a standard plan delivery mode: not requiring the attachment of film jigs or detectors to the collimator, nor requiring the manual manipulation of the CK robot.

Unique to this device is the technique in which MLC performance is evaluated. By taking advantage of the 200 micron/pixel resolution, acquired images of Garden Fence patterns are compared to baseline images. Following automated image registration of the acquired image to the baseline image, a difference image is rendered and analyzed. Average pixel intensities and pixel areas at the location of leaf edges are compared to empirically-determined threshold values. These threshold values were determined by delivering a calibration field with induced leaf offsets of 0.1 mm to 1.0mm, in increments of 0.1mm. With the desire to have the threshold-of-failure set to leaf inaccuracies of greater than 0.2mm, threshold values for average pixel intensity and pixel area were appropriately selected.

During a five-month study, the QASC was used to evaluate MLC performance every morning prior to treatment. During this evaluation, there were no instances of leaf inaccuracy greater than 0.2mm. Being filmless, automatically aligned with the TLS, and having an efficient automated analysis workflow, the QASC required five minutes for setup, delivery, and analysis.

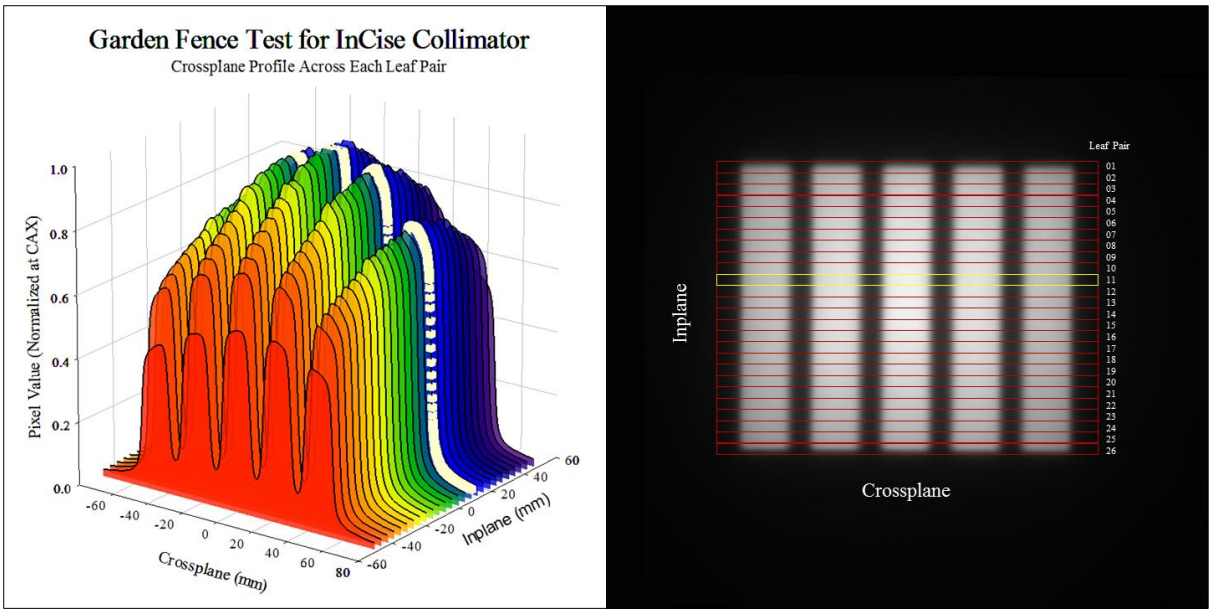


Figure 1. Acquired using the QA StereoChecker, the normalized pixel profiles across each of the 26 leaf pairs of the InCise Multileaf collimation system following the delivery of a Garden Fence pattern.

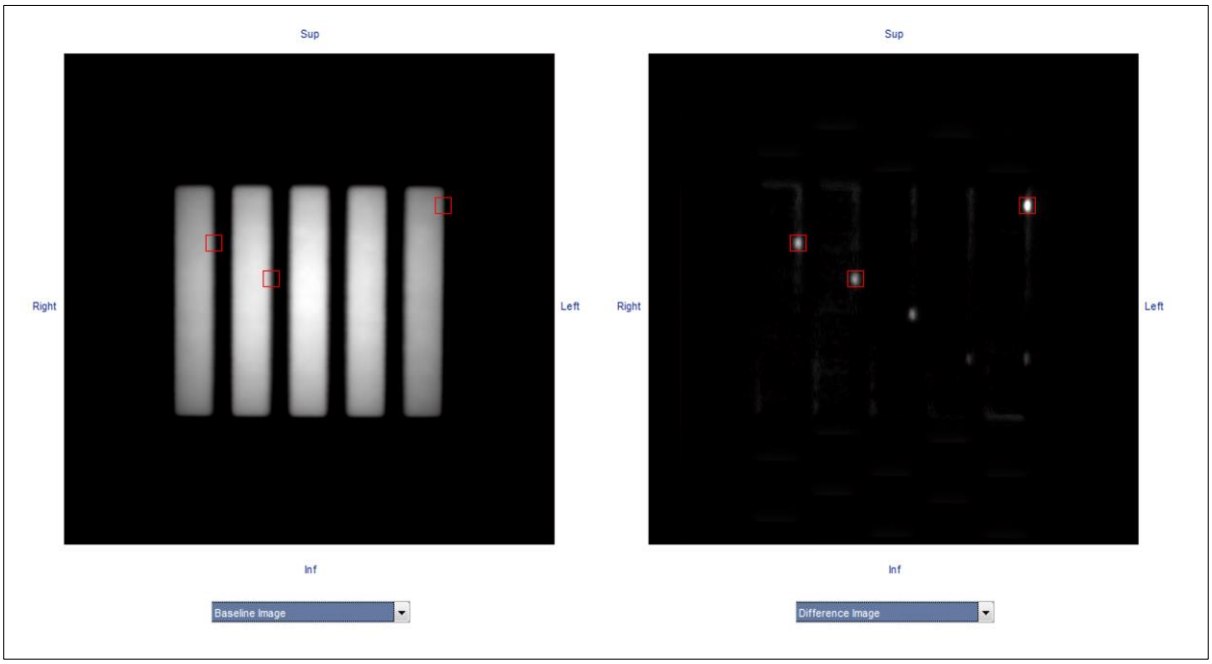


Figure 2. Following acquisition, and the automated registration of the acquired image to a baseline image, a difference image is analyzed. Pixel values and pixel areas corresponding to leaf edges are compared to threshold values which are determined using plans with induced MLC leaf position errors. The red squires denote the locations of leaf edges where the MLC position is out-of-tolerance. The images show the results of an analysis where the failure is considered a leaf position error exceeding 0.2mm.