

Purpose: This study characterizes the image performance of the megavoltage computed tomography (MVCT) imaging from the Hi-ART II tomotherapy treatment unit using measures of noise, uniformity, contrast, linearity, and spatial resolution as a function of absorbed dose.

Method and Materials:

MVCT image performance was characterized using a AAPM CT Performance Phantom. The following tests were performed as a function of collimator pitch and image pixel size: image noise, spatial uniformity, objective (modulation transfer function) and subjective (hole patterns) spatial resolution, contrast linearity, and contrast-detail resolution. The multiple scan average dose (MSAD) was determined in a 20 cm diameter cylindrical phantom as a function of collimator pitch, and the beam energy was estimated from percent depth dose measurements.

Results: The uniformity and spatial resolution of MVCT images generated by the HI-ART II are comparable to that of diagnostic CT images. The MVCT scan contrast is linear with respect to electron density of target material. MVCT images do not have the same performance characteristics as state-of-the-art diagnostic images based on objective measures of noise and low-contrast resolution, but large object low contrast resolution is sufficient to for identification of many important soft tissue structures. The MSAD ranges from 0.25 cGy to 1.1 cGy, and the effective beam energy is 3.5 MV.

Conclusion: MVCT images from the Hi-ART II are adequate for verifying a patient's position at the time of radiation therapy. These images also provide sufficient contrast to delineate many soft-tissue structures. Hence, these images are adequate for reconstruction of the dose actually delivered to anatomical structures during radiotherapy. The dose delivered by the MVCT is low enough that images can be acquired on a daily basis.