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Towards reducing the dose needed for Megavoltage Cone Beam CT

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Megavoltage (MV) x-ray beams generated from a linear accelerator (linac) are commonly used to deliver the prescribed radiation dose to the tumor while minimizing the dose to the surrounding healthy tissues. The geometric accuracy of such treatment is crucial for its success. Currently, there are a number of ways to verify the positional accuracy of the treated target. Megavoltage cone-beam computed tomography (MV-CBCT) is the simplest and arguably least error-prone solution of all the commercially available volumetric imaging methods to locate the position of the target in the treatment room prior to the start of the treatment. MV-CBCT uses an electronic portal-imaging device (EPID) attached to the linac to acquire CT data by rotating the MV x-ray source, emitting a cone beam, and the EPID around the patient. However, due to poor x-ray quantum efficiency of EPIDs that are utilized in clinics presently, the imaging dose required to achieve sufficient contrast to visualize and delineate soft tissue targets can be prohibitively large for daily verification with this imaging modality.

Recently, a family of detector designs that have the potential to solve the low x-ray conversion efficiency challenge faced by current clinical EPID systems has been investigated. In these, over an order of magnitude higher quantum efficiency, when compared to current clinical systems, is achieved by using a few centimeters thick x-ray conversion layer. To maintain spatial resolution the x-ray conversion layer is segmented in the directions parallel to the incident x-rays.

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