Medical Physics

PhD theme

Title: Development of the 256-slice CT scanner and its advantages in four-dimensional charged particle therapy

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To allow four-dimensional (4D) imaging (volumetric data plus time dimension) with a wider field of view (volumetric cine imaging), a 256-multislice CT (256MSCT) has been developed at the National Institute of Radiological Sciences in Japan. The increase in the number of detector rows allows an isotropic resolution of less than 0.5 mm and wide longitudinal coverage (=128 mm) in a single rotation, greatly facilitating the production of volumetric cine images of moving organs.

However, since a cone-beam scan along a circular orbit does not collect the complete set of data in Radon space required for exact reconstruction of a volume, Feldkamp artifacts occur with increasing frequency as cone angle widens. A number of evaluations have therefore been conducted to confirm the 256MSCT's use in radiotherapy.

Results have shown that physical performance and clinical image quality with the 256MSCT are closely similar to those with the latest MSCT. Regarding dose, a newly established dose assessment for cone-beam CT showed that dose is equal to or less than that with conventional CT. Dose is increased with the increased scan time in cine mode; however, this has been reduced via the development of a new compensation filter.

To adapt the 256MSCT to 4D radiotherapy using a charged particle beam, the effect of temporal resolution on carbon beam dose distribution was evaluated in patients with lung cancer using the respiratory correlated reconstruction algorithm to increase temporal resolution. Results confirmed the suitability of 256MSCT for adaptation to 4D radiotherapy using charged particle therapy.