

Application of Cone beam CT Isocenter Adjustments in Image Reconstruction

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Abstract

The Cone Beam Computed Tomography (CBCT) System at Fermilab is being developed to accurately locate tumors and characterize the surrounding anatomy prior to Neutron Therapy (NT). The aim of this project is to aid accurate prediction of the position of the CT isocenter. This is necessary to ensure spatial isotropy in the reconstructed CT images. The benefits of a cone beam CT include reduction in the total scan time as well as the amount of radiation dosage affecting normal tissue located around cancerous cells. Developed reconstruction algorithms need to be precise to about one degree of rotation. The cone beam CT now being developed will be used alongside the vertical CT to characterize the tumor volume prior to irradiation. At Fermilab, the neutron therapy facility is constructed around a linear accelerator (LINAC), hence the beam is applied in a fixed horizontal position on a lower level while the patient is sitting or standing on a rotating platform. With the location of the beryllium target and collimators well below ground level, an elevator is required to move the patient down from the upper CT level for treatment at the lower NT level after the initial CT scan. The elevator has been determined to have a pitch in the x-y plane (upstream of the beam and transverse to the movement of the elevator). This results in a pixel offset in the reconstructed image. This paper covers the various methods and experiments aimed at measuring the offsets as well as their application in the image reconstruction algorithm.

Key words: isocenter, cone beam CT, alignment, offsets