Slow gantry rotation for respiratory correlated inverse geometry computed tomography

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Purpose: The inverse geometry computed tomography (IGCT) has been developed to overcome the several limitations in conventional cone beam computed tomography (CBCT). We intend to present the projection acquisition condition for respiratory correlated 4D IGCT with the slow gantry rotation technique of conventional 4D CBCT.

Materials and Methods: The projection data of IGCT is a group of narrow cone-beam projections at a certain gantry angle. The projection groups (PG) acquired over a single gantry rotation in several minutes and a gridding was performed to transform the sorted PG to cone beam geometry. Each PG covered the radon space with specific angular width, and the angular distance between successive PGs should be less than 0 degree to perform the accurate gridding without vacancy in radon space. Two simulations, met and failed condition, were performed to validate the acquisition conditions. Applying the regular breathing pattern of 4 s period sine wave, virtual IGCT PGs were acquired for 3 virtual phantoms, defrise, modified Shepp-Logan and XCAT torso. The PGs were sorted into 10 phases and the FDK reconstruction was independently performed at each phase.

Results: Under the acquisition condition, the 4D IGCT had uniform image without cone-beam artifact and motion artifact compared with the conventional CBCT image. On the other hand, the gridded projection showed inaccurate interpolation, especially in the large radial distance area, and the image quality was poor under the failed condition.

Conclusions: The 4D IGCT demonstrated its imaging ability without cone beam artifact and motion artifact. In order to obtain a fine image quality without significant artifacts, it is necessary to satisfy the projection acquisition condition of IGCT.

Keywords: Inverse geometry CT, respiratory correlated CT, cone-beam CT