AbstractID: 9130 Title: Optimization of dose efficiency in helical scan and image reconstruction at dynamically variable pitches

Purpose: To present a cone beam helical image reconstruction algorithm for CT diagnostic imaging at dynamically variable pitches and its optimization in dose efficiency.

Method and Materials: The ray-wise 3D weighted helical cone beam filtered backprojection (CB-FBP) algorithm is extended to carry out image reconstruction at dynamically variable helical pitch, in which the filtering process is carried out in the cone-parallel geometry along the tangential direction of the helical source trajectory. Consequently, the filtering paths are straight lines at dynamically invariable pitch, but become curves at dynamically variable helical pitches. In addition, since the pitch variation may be caused by either acceleration or deceleration, the filtering paths can be curves containing inflexions. The FORBILD head and thorax phantoms are utilized to evaluate the performance of the extended algorithm. The dynamical variation range of normalized helical pitch in the evaluation is between 0.5:1 and 1.5, which is quite large from the perspective of clinical applications. Moreover, the optimization in dose efficiency is studied by evaluating the noise characteristics at various transitions of helical pitches.

Results: The phantom study shows that, at a wide variation of helical pitches, the extended ray-wise 3D weighted helical CB-FBP algorithm can provide a well-balanced imaging performance over reconstruction accuracy, spatial resolution and noise characteristics, while a large field of view can be maintained. Meanwhile, the noise uniformity of the presented algorithm can be improved by optimizing the ray-wise 3D weighting parameters with the dynamic variation of helical pitch during the scan.

Conclusion: Based on the experimental evaluation, especially its robustness over a large variation range of helical pitches, it is expected that the extended ray-wise 3D weighted CB-FBP algorithm can meet the challenges posed by advanced clinical applications, in which helical scanning and image reconstruction at dynamically variable pitches and maintenance of noise characteristics are demanded.