AbstractID: 11660 Title: Slow Gantry Rotation Acquisition Protocol for Four-Dimensional Digital Tomosynthesis

Purpose: Four-dimensional digital tomosynthesis (4D-DTS) was recently introduced as a novel on-board 4D imaging technique. The purpose of this study is to develop and implement a slow gantry rotation acquisition protocol for 4D-DTS. A formalism for determining appropriate acquisition parameters based on patients' respiratory characteristics was derived and tested.

Methods & Materials: Equations were derived to explain the relationships between slow gantry acquisition parameters (scan speed, frame rate and scan angle) and respiratory characteristics (average period and regularity). Additional equations relate acquisition parameters with resultant scan times, projection numbers and the distribution of projections within phase bins once sorting and binning are complete. Phantom studies were conducted to test the new protocol. A body phantom was mounted on a moving platform to simulate short and long respiratory cycles (3 and 6-s) and scanned using the slow gantry protocol with a 1.1-deg/sec scan speed and a 7.8-fps frame rate. Projections were binned and sorted into 10 phases with 10% phase windows. Resultant distributions of projections within phase bins were compared with expected distributions based on the derived formalism. Reconstructions were completed to investigate dependence on respiratory period.

Results: The maximum angular intervals between projections within phase bins were estimated by the formalism to be 3.5 and 6.8^{o} for the 3 and 6-s profiles, respectively. Actual values ranged 3.4 to 3.6^{o} for the 3-s profile and from 6.8 to 7.16^{o} for the 6-s profile. Reconstructions demonstrated the importance of adjusting scan speed according to respiratory cycle length.

Conclusion: A 4D-DTS slow gantry rotation acquisition protocol was developed, implemented, and tested. The derived formalism has proven useful for determining appropriate acquisition parameters based on respiratory characteristics and will be used as a framework for further optimization and testing of the protocol.

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