AbstractID: 13211 Title: Self-sorted Four-Dimensional Magnetic Resonance Imaging: a Feasibility Study

Purpose: Considerable imaging dose to health tissue of patient from 4D-CT is often a concern. This study is to develop a four-dimensional magnetic resonance imaging (4D-MRI) technique based on retrospective sorting strategy that uses body volume as respiratory surrogate.

Method and Materials: Respiratory signals are determined by body volume changes at each slice location. Respiratory phases were subsequently calculated for each image and used in 4D-MRI retrospective sorting. The technique was tested on motion phantom (in a sinusoidal motion pattern: amplitude 2.0cm, period 5 seconds) and on three healthy volunteers. Phantom images were acquired on 1.5T GE MR scanner using fast imaging employed steady state acquisition (FIESTA) sequence and human images were acquired on 1.5T Siemens MR scanner using similar sequence (True-FISP) with the following imaging parameters (TR/TE, 3.7ms/1.21ms; Matrix, 256x166; FOV, (300-350)x(227-300)mm; flip angle, 52°; slice thickness, 5mm). Frame rate was around 2.5frames/second. All image sets were acquired in axial planes with multiple slices to cover entire interested volume. Each slice was imaged for slightly more than one breathing cycle. A single sagittal cine-MRI was also acquired on phantom to serve as a reference for motion evolution.

Results: Sinusoidal motion of phantom was clearly seen in all three planes with minimal artifacts. Sagittal images from 4D-MRI matched with those from sagittal cine-MRI (mean difference in amplitude: -0.3±0.5mm). In volunteers' study, internal organ motion of the lungs, liver, and/or kidneys were clearly revealed in 4D-MRI. Image artifacts were more noticeable than in phantom study, presumably due to subjects' breathing irregularity.

Conclusions: These preliminary results on phantom and healthy volunteers demonstrated the feasibility 4D-MRI using body volume as the respiratory surrogate. This technique has the potential to evaluate tumor motion in most body sites without any radiation dose.