

## **HIGH SPATIAL AND TEMPORAL RESOLUTION MYOCARDIAL TAGGING IN A FREE-BREATHING EXAM USING MULTI-ECHO SSFP AND PAGE**

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### **PURPOSE**

Magnetization tagging has been used to study regional myocardial motion. Development of higher resolution tagged imaging methods would permit motion evaluation in early systole and diastole for the evaluation of regional activation and relaxation patterns.

### **METHOD AND MATERIALS**

The pulse sequence was developed by combining a multi-echo steady-state free precession (MESSFP) readout scheme (to take advantage of its higher SNR) with a phased array approach to ghost elimination (PAGE). While the zeroth gradient moment was nulled in all three directions, the first gradient moment was nulled in the readout and slice-select directions. The use of the PAGE technique enables minimization of the first gradient moment in the phase-encoding direction. The coil sensitivity profile was determined adaptively over the entire study. Combined cardiac and respiratory gating was incorporated in order to permit the acquisition of the high-resolution data under free-breathing conditions. In order to minimize the artifacts that arise when transitioning from the tagging pulse to the MESSFP readout, a geometric ramp flip angle was used for the first 5 readout pulses. The sequence was implemented on a 1.5 T clinical scanner (Sonata, Siemens Medical Solutions), and evaluated on human volunteers and patients. Typical scan parameters were: ETL:3, TR:7ms TE:3.57 ms (to central echo), FOV: 320 x 320 mm<sup>2</sup>, Resolution: 384 x 234 pixel<sup>2</sup>, slice thickness: 8mm, flip angle: 40°, respiratory acceptance window: 15% of end-expiration, Bandwidth: 868 Hz/pixel, tags: 5-7-9-7-5, spacing: 6 mm, phased array elements: 6 (4 ant., 2 post.).

### **RESULTS**

Using the approach presented above, we acquire tagged cine images with spatial resolution of 0.8 mm X 1.4 mm (frequency-encoding direction X phase-encoding direction), and temporal resolution of 7 ms. Typical acquisition times for these scans ranged between 4 and 6 minutes per slice.

### **CONCLUSIONS**

The combination of multiecho SSFP, PAGE and cardiac and respiratory gating has been used to obtain high resolution (temporal and spatial) myocardial wall motion data over the cardiac cycle. This should permit evaluation of regional activation and relaxation patterns in the heart.