A Cardiac Technique for Multiple Mouse MRI

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Introduction Multiple mouse magnetic resonance imaging (MMMRI) has recently been introduced for high-throughput imaging of large numbers of mice [1]. The feasibility of this technique for cardiac imaging is the subject of this abstract. The main challenge for cardiac MMMRI is that with a common gradient coil there is no way to implement any form of prospective gating because the heartbeats of the individual animals are asynchronous. In this abstract, we use a single mouse to show that retrospective gating with simultaneously acquired cardiac and respiratory waveforms allows for cardiac MMMRI.

Materials and Methods Combined retrospective cardiac and respiratory gating has been described previously for human imaging [2,3,4]. Briefly, the pulse sequence runs continuously, and as a result is asynchronous to the physiologic waveforms. The ECG and respiration are recorded in time reference to the entire scan. At the completion of the scan, each k-space frame is assigned a cardiac and respiratory phase based on the recorded waveforms. The respiration monitor data are first used to discard any data which may be adversely affected by motion. The remaining k-space data are then sorted and interpolated from the sampled time points to the time points of the desired cardiac reconstruction frames

A normal mouse was anaestheized with ~1.0% isofluorane gas and imaged with a 7 Tesla MRI scanner (Varian Unity^{INOVA}, Palo Alto CA). ECG and respiration were monitored and recorded separately with commercial hardware (SA Instruments Inc, Stoneybrook, NY). Three-dimensional gradient-echo imaging parameters were TR/TE = 10/2.1 ms, matrix=160x160x16, voxel size = 150x150x750 um^3. For each phase encoding value, 80 temporal samples of the cardiac cycle were obtained. Total scan time was about 30 minutes. In a second experiment, a prospectively gated data acquistion was made for comparison with the retrospective reconstructions.

Results In figure 1, one slice of the acquisition volume is shown at nine temporal phases of the cardiac cycle. In this figure, about 30% of the data have been discarded for respiratory motion, and the remainder combined to reconstruct each time point with 3 signal averages (NEX=3). Quantitative measurements of ghosting artifacts showed that retrospective imaging had near-equivalent quality to prospective imaging.

Conclusions We have shown a protocol by which cardiac cine images may be reconstructed from asynchronous temporal data acquired from multiple mice. Although we have only scanned a single mouse to date with this protocol, the method extends to multiple mice with no additional procedures.

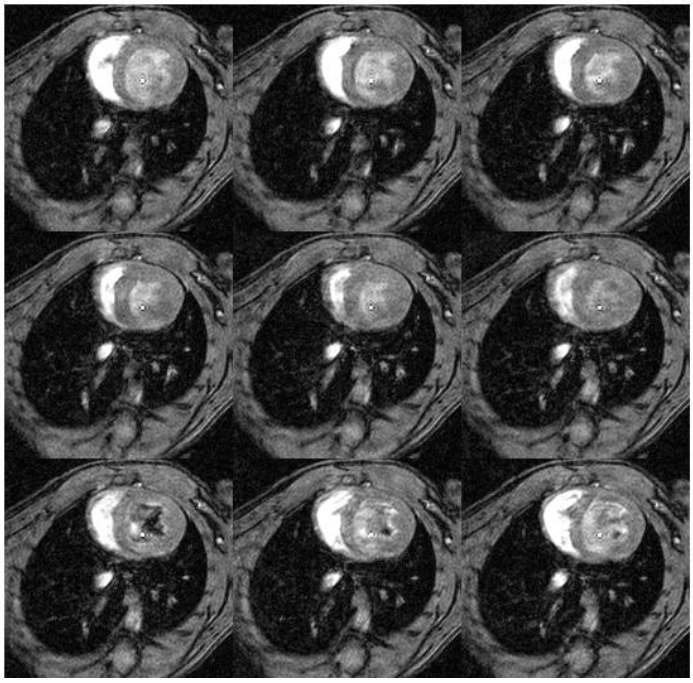

Figure 1. Nine temporal frames from a retrospectively gated mouse cardiac scan at 7T.

References

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