# Multiple Mouse Imaging of 16 Live Mice

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**Introduction** Multiple mouse magnetic resonance imaging has been introduced for high-throughput imaging of large numbers of mice [1]. Previously, partially parallel imaging in seven live mice has been employed on a four-channel scanner with a time-interleaved acquisition scheme [2]. In this work, we demonstrate fully parallel imaging of 16 live mice and report further results on the scalability of live multiple mouse imaging.

**Materials and Methods** Sixteen normal mice were prepared for physiologic monitoring a day in advance of scanning with Nair™ hair removal product. In two sequential batches of 8 mice, they were induced with isofluorane, loaded onto plastic sleds with built-in monitoring probes and head straps (Dazai Research Instruments, Toronto ON), and inserted into plastic centrifuge tubes. After placement of the mice in the coil array, the 16 quadrature Millipede™ coils were tuned for frequency and impedance matching. Brain imaging was conducted at 7T with a 16 channel transmit/receive console (VMRIS DirectDrive, Varian Inc., Palo Alto CA). Prescan for independent centre frequency and flip angle per mouse was followed by spin-echo multi-slice imaging with TR/TE=1800/15 msec, NEX=2, in both sagittal and transverse imaging planes, at a pixel resolution of 100x100x1000 μm. The ECG, respiration and temperature for all mice were monitored simultaneously with custom hardware (SA Instruments Inc, Stony Brook NY). The scanning protocol was repeated on a second day.

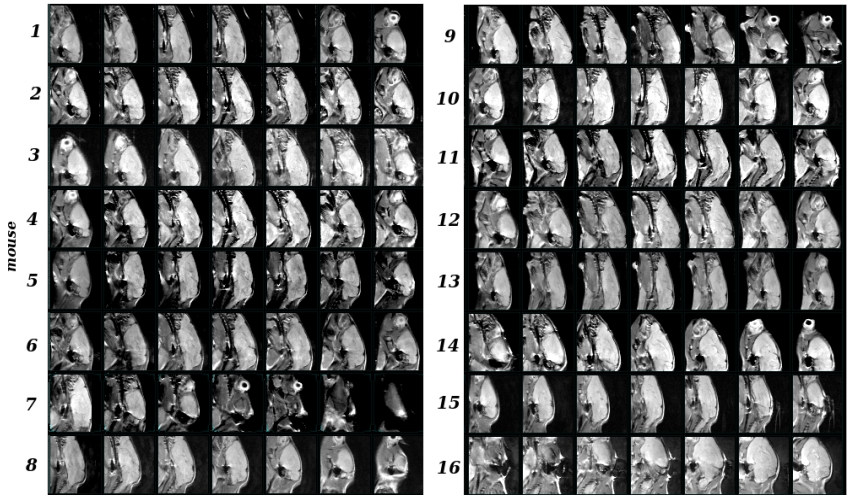


**Figure 1:** Zoomed brain images of 7 sagittal slices from 16 mice. Window/level not identical.

**Results** In figure 1, 7 sagittal slices are shown for the 16 mice. Figure 2 shows a single slice from each mouse. In the latter figure, lower SNR is noted in coils 3,5 which were pending service for tuning. Other images show lesser variations due to normal differences in the animals and coils. Some images show a minor zipper artifact due to imperfect FID suppression in the live mice. While standard phase cycling places unsuppressed, un-encoded magnetization at the edges of the field-of-view (FOV) for the coil at the gradient isocentre, other coil positions have non-integral offsets in units of FOV. The tx/rx phase for each coil can be assigned so as to place un-encoded magnetization at the edge of the associated FOV, but this has not yet been programmed on our system. Table 1 shows time taken during experiment preparation, as well as mouse survival. While the scanner can be running on other protocols during induction/loading, it must be available during coil tuning. Tuning time reflects some change from previously scanned fixed mice and phantoms, and could be somewhat lower on consecutive runs with batches of live mice having similar loading characteristics. Mouse survival < 100% may indicate a shortcoming of our present apparatus, in that the controls for heating and gas delivery are common to all animals so mouse physiology cannot be individually adjusted during the scan session. Given a practical limit of four hours maximum anaesthetization time, the nominal 16-fold gain in throughput is lessened somewhat by the 25% reduction in available scan time. Depending on the protocol, an achievable gain in throughput of 12 or 13-fold over single mouse imaging seems likely.

**Table 1: Experimental preparation times**

| *Experiment* | *Induction/ Loading (min)* | *Coil Tuning (min)* | *Survival* |
|---|---|---|---|
| 1 | 45 | 13 | 15/16 |
| 2 | 55 | 13 | 16/16 |

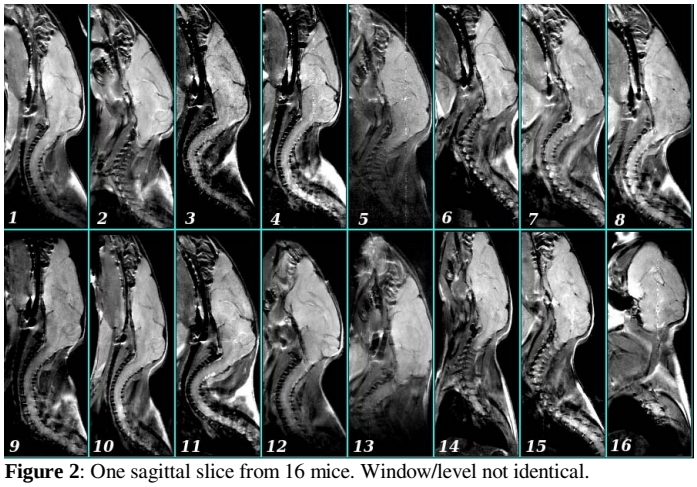


**Figure 2**: One sagittal slice from 16 mice. Window/level not identical.

**Conclusions** Preliminary brain images of 16 live mice scanned in parallel have been obtained, and with respiratory and cardiac gating [3] the method is also applicable to body protocols. We have demonstrated that 16 mouse live imaging is feasible and that the increased throughput responds effectively to the needs of genome scientists studying mouse models of human disease.

**References**

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[3] Bishop J, Feintuch A, Bock NA, et al. Retrospective gating for mouse cardiac MRI. Magn Reson Med. 2006; 55(3):472-7.