

2. Abstract

Magnetic resonance imaging (MRI) systems, like many advanced technologies, develop rapidly due to both engineering and scientific advances. MRI systems in the Bioimaging Core Facility at UNMC are 5 and 10 years old, respectively, and require hardware and software upgrades to provide state-of-the-art MRI. Hardware is incompatible with current software releases on one scanner. The other scanner can only run a portion of the available sequences due to hardware limitations. Hardware and software upgrades will provide state-of-the-art capabilities crucial to advancing preclinical studies in the areas of nanomedicine and basic neuroscience, among others. New capabilities will include parallel imaging (GRAPPA), required to allow one-shot MRI (echo planar imaging) to be robust at high field. Robust single shot imaging will allow full brain or full body quantitative scans of small animals to be completed in 1-2 minutes rather than the current 10-20 minutes per scan. These capabilities will provide whole brain/body mapping while allowing for rapid throughput of animals, reducing costs and increasing productivity for all investigators. Zero echo time imaging (SWIFT) capability will allow, for the first time, quantitative positive contrast from superparamagnetic iron oxide labeled drug delivery nanoformulations. Concentration maps of iron oxide labeled nanomaterials at nanomolar and lower concentrations can be acquired in small animals using this new method. In addition, upgrades will produce significant technical enhancements in many critical subsystems including a 20-40% boost in signal-to-noise from fully digital receiver hardware. Importantly, hardware upgrades will allow future software releases to be compatible with hardware for many years into the future.