MRI Hardware

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The textbook formulation of MRI is typically framed with uniform fields, well-controlled linear gradients and stationary objects. Modern model-based iterative image reconstruction methods perhaps with prior knowledge to guide unstable inversion problems, provides new-found power to the hardware engineer who can now rest-easy knowing that the images can be reconstructed under nearly any circumstance. Relaxing the hardware requirements, in turn, has the potential to reduce cost, siting and operational burdens. This directly benefits healthcare by increasing the number of patients with access to MRI examinations and tilting its cost-benefit equation to allow more frequent and varied use. The introduction of low-cost, and/or truly portable scanners could also enable new point-of-care and monitoring applications not feasible for today's scanners in centralized settings.

This talk examines the technical forces and tradeoffs that might facilitate a large step forward in the push to "jail-break" MRI from its centralized location in healthcare and allow it to reach larger patient populations and achieve new uses. We examine hardware costs and potential alternative approaches to hardware design and image encoding, especially with a view toward truly portable or point of care (POC) MRI. We also examine some of the biological constraints holding back high-end gradient design, such as Peripheral Nerve Stimulation (PNS). As biology becomes firmly entrenched in the engineering, the creation and exploitation of new degrees of freedom is needed to navigate these biological constraints. In this case, the hardware must be guided by a solid biological model, which we only recently have for PNS in gradient coil design.