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Advanced Magnetic Resonance Neuroimaging at 0.5-Tesla?... This is not your parent's MRI!

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For almost five decades, Magnetic Resonance Imaging (MRI) has been on a monotonic technological progression towards higher and higher magnetic field strength. This is largely due to the fact that, as any physicist will tell you, nuclear magnetization and therefore MR signal strength scales with the applied field strength. Why then go backwards to a low magnetic field to explore advanced neuroimaging when "everyone knows" we should be using high magnetic fields in MRI?

While strong magnetic field confers many benefits –e.g. bigger chemical shifts, stronger fMRI contrast, etc – it is not a panacea. In contrast, MRI at lower magnetic field exhibits decreased spatial distortion due to lower susceptibility induced field inhomogeneity, decreased RF heating of tissue, improved RF pulse B1 homogeneity, etc. We have recently explored the use of a novel MRI device (Synaptive Medical Inc, Toronto ON) that utilizes a cryogen-free head-only 0.5-T magnet with 16-channel fully digital receive chain and a 100 mT/m gradient set with a usable slew rate of 400 T/m/s. The introduction of modern spectrometer design to a 0.5-T magnet has permitted us to explore a range of advanced neuroimaging applications. This allows us to take advantage of all the benefits of low field while mitigating the drawbacks of decreased signal strength through improved T/R chain and gradient coil design.

Through this research we will explore a spectrum of advanced neuroimaging applications of this technology including:
• "Distortion Free"Diffusion Weighted Imaging, leveraging the high strength/slew gradient design;
• "Band Free"balanced SSFP imaging of internal auditory canal, leveraging the improved field homogeneity and low RF specific absorption rate inherent to low magnet field;
• Accelerated MR screening exams for use in stroke imaging, leveraging the high performance receive chain for generating excellent SNR images.

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