

Software-Defined Energy-Harvesting RF Coils for High-Field Brain Magnetic Resonance Imaging

Shumin Wang

RF field inhomogeneity is a major issue in high-field Magnetic Resonance Imaging. Dominating methods that apply phased arrays to improve field homogeneity require expensive multiple-channel RF transmission with independent phase and amplitude control. By removing redundancy in such systems, a new method is introduced that only requires single-channel RF transmission and frequency detuning. It utilizes an array of small coils that harvest electromagnetic energy generated by a conventional large volume coil. By adjusting the self-resonant frequency appropriately, field inhomogeneity is compensated by re-radiation from small coils. The principles and proof of concept will be demonstrated at first. For practical applications, magnetic field profiles and safety issues need to be evaluated for each subject. In order to provide fast and reliable solutions, we further developed a software-based approach that includes automatic subject modeling and fast numerical methods for solving Maxwell's equations. The fundamental theory will be discussed and simulation results of real subjects will be used to demonstrate the capability of this approach.