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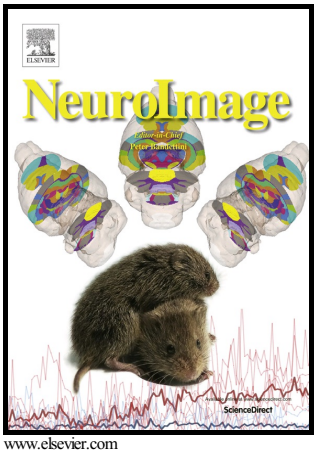

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Pulse sequences and parallel imaging for high spatiotemporal resolution MRI at ultra-high field

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Keyword

Ultra-high field, parallel imaging, CAIPIRINHA, wave-CAIPI, simultaneous multi-slice, BOLD fMRI, dw-EPI, structural MRI, QSM

Abstract

The SNR and CNR benefits of ultra-high field (UHF) have helped push the envelope of achievable spatial resolution in MRI. For applications based on susceptibility contrast where there is a large CNR gain, high quality sub-millimeter resolution imaging is now being routinely performed, particularly in fMRI and phase imaging/QSM. This has enabled the study of structure and function of very fine-scale structures in the brain. UHF has also helped push the spatial resolution of many other MRI applications as will be outlined in this review. However, this push in resolution comes at a cost of a large encoding burden leading to very lengthy scans. Developments in parallel imaging with controlled aliasing and the move away from 2D slice-by-slice imaging to much more SNR-efficient simultaneous multi-slice (SMS) and 3D acquisitions have helped address this issue. In particular, these developments have revolutionized the efficiency of UHF MRI to enable high spatiotemporal resolution imaging at an order of magnitude faster acquisition. In addition to describing the main approaches to these techniques, this review

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