Three-dimensional reduced field-of-view imaging

This study aimed at developing a 3D reduced field-of-view imaging (3D-rFOVI) technique using a 2D radiofrequency pulse, and demonstrating its ability to achieve isotropic high spatial resolution and reduced image distortion in echo planar imaging (EPI).

The proposed 3D-rFOVI technique takes advantage of a 2D RF pulse to excite a slab along the conventional slice-selection direction (i.e., z-direction) while limiting the spatial extent along the phase-encoded direction (i.e., y-direction) within the slab. The slab is phase-encoded in both through-slab and in-slab phase-encoded directions. The 3D-rFOVI technique was implemented at 3T in gradient-echo and spin-echo EPI pulse sequences for functional MRI (fMRI) and diffusion-weighted imaging (DWI), respectively. 3D-rFOVI experiments were performed on a phantom and human brain to illustrate image distortion reduction, as well as isotropic high spatial resolution, in comparison with 3D full-FOV imaging.

In both the phantom and the human brain, image voxel dislocation was substantially reduced by 3D-rFOVI when compared with full-FOV imaging. In the fMRI experiment with visual stimulation, 3D isotropic spatial resolution of (2 × 2 × 2 mm3) was achieved with an adequate signal-to-noise ratio (81.5) and blood oxygen level-dependent (BOLD) contrast (2.5%). In the DWI experiment, diffusion-weighted brain images with an isotropic resolution of (1 × 1 × 1 mm3) was obtained without appreciable image distortion.

This study indicates that 3D-rFOVI is a viable approach to 3D neuroimaging over a zoomed region [1)].

1)
Sun K, Zhong Z, Dan G, Karaman M, Luo Q, Zhou XJ. Three-dimensional reduced field-of-view imaging (3D-rFOVI). Magn Reson Med. 2021 Dec 11. doi: 10.1002/mrm.29121. Epub ahead of print. PMID: 34894639.