

Controlling the Acoustic Spectrum in Fast MRI to Reduce Noise and Imaging Artifacts

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Principal investigator

Rita Schmidt

Faculty of Biology
Department of Brain Sciences

Overview

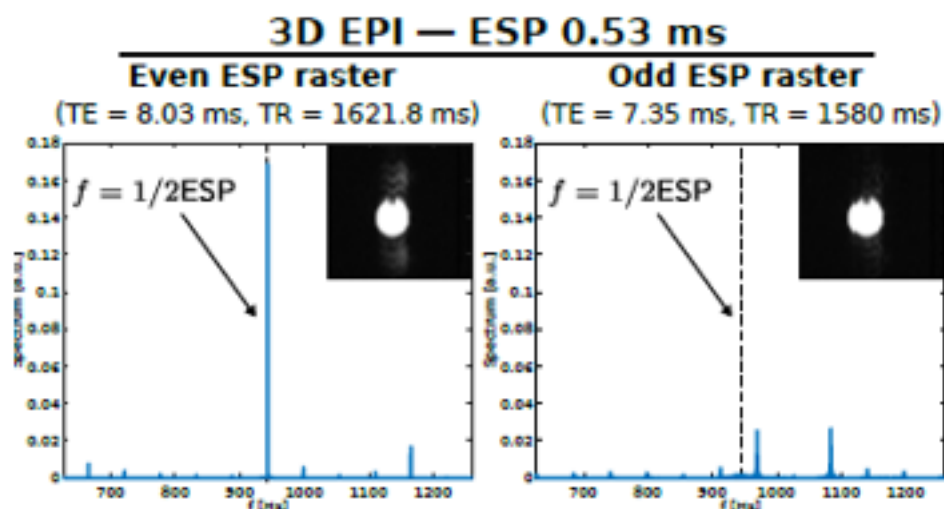
Fast MRI sequences such as echo-planar imaging (EPI) generate strong mechanical vibrations in the scanner, producing loud sounds, image ghosting, and possible hardware strain, issues that are amplified at ultra-high magnetic fields. This technology introduces a model-based method for predicting and controlling the acoustic spectrum in MRI by subtly adjusting timing parameters (echo and slice timing). These adjustments lower sound levels, mitigate ghosting artifacts, and enhance image quality.

Applications

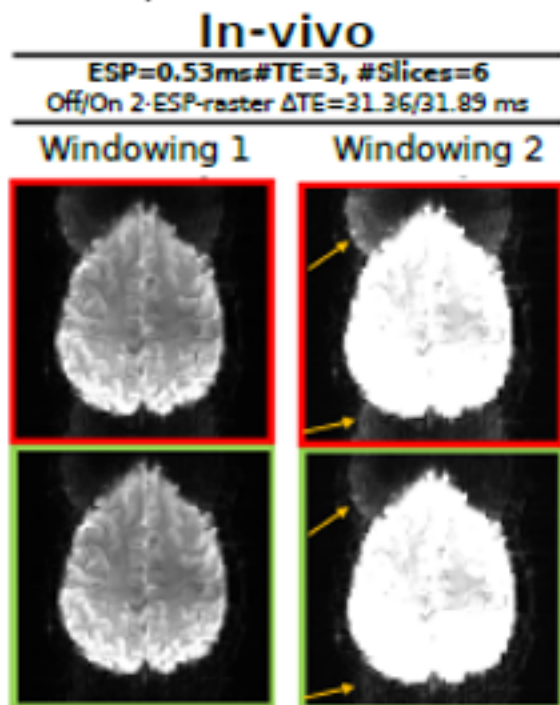
- Low-noise MRI protocols for sensitive patient populations (e.g., infants, anxiety-sensitive subjects).
- Improved safety by minimizing mechanical vibrations that can lead to gradient or coil failure.
- Enhanced image quality through significant reduction of ghosting artifacts.
- Optimization of high-field MRI protocols (7 T and above) without hardware modification.

Differentiation

- Predicts acoustic modes and peaks directly from gradient waveforms
- Reduces noise and ghosting via minor timing adjustments instead of hardware changes
- Replaces restrictive “forbidden-frequency” rules with model-based vibration prediction



Minor TR and TE adjustments in 3D-EPI significantly affect ghosting and acoustic



A significant ghost reduction (bottom, green-framed images) was achieved by a small change to Δ TE.

Development Stage

A validated model of the acoustic spectrum was developed and experimentally confirmed on a 7 T Siemens MAGNETOM Terra system using both phantom and in-vivo imaging. The approach was shown to reduce acoustic peaks and image ghosting by tuning timing parameters in multi-echo and multi-slice EPI. Ongoing work aims to incorporate system-specific mechanical resonances to further refine the predictive power and facilitate integration into commercial MRI pulse-sequence software.

