Sara: Synthetic Anatomy for Radiological Applications – Generating a Functional MRI Phantom

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Functional magnetic resonance imaging (fMRI) is a crucial tool for understanding human brain function, offering non-invasive insights into cognition and clinical neurological disorders like schizophrenia, Alzheimer's, and epilepsy. fMRI uses fast imaging sequences like echo-planar imaging which are sensitive to the blood oxygenation level-dependent effect associated with neural activity. Applications in fMRI span from diverse aspects of cognition to clinical. However, technical challenges have impeded its clinical utility, particularly in data processing and quality assurance (QA). The reliability and validity of fMRI studies depend on QA protocols' availability. QA protocols typically use physical phantoms for assessing and optimising MRI scanner performance. Physical phantoms are particularly useful for calibrating scanners and designing pulse sequences for fMRI validation.

To address these technical challenges, we proposed the development of brain-mimicking phantoms capable of generating and modifying $T2^*$-based signals, enhancing fMRI reliability. Our approach involves incorporating signal-producing biomolecules into anthropomorphic brain phantoms, a concept absent in current research. We aim to improve signal-to-noise and contrast-to-noise ratios and facilitate early and reliable diagnoses. Through these efforts, we aspire to provide future researchers and medical professionals with a valuable tool while deepening our understanding of fMRI effects. Ultimately, we aim to design more robust tools for future research endeavours, thereby contributing to the advancement of the field.