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Title:	Revolutionizing MEG: Noninvasive Laminar Inference of Cortical Activity
Authors:	Agarwal, Ishita
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Abstract:	The landscape of neuroimaging research has long wrestled with the intrinsic challenge of balancing temporal and spatial resolution in the non-invasive study of the human brain. Conventional methodologies, including functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and magnetoencephalography (MEG), have historically exhibited limitations in providing both high temporal and spatial precision. This critical gap in our understanding of neural dynamics has motivated the exploration of alternative avenues, leading to recent breakthroughs in high precision MEG (hpMEG). Recent breakthroughs in high precision MEG (hpMEG) have, however, showcased newfound sensitivity to the orientation of cortical columns, challenging traditional notions of MEG's spatial resolution. Leveraging these advancements, my research aims to develop a groundbreaking framework for laminar inference using hpMEG. Through the utilization of a custom forward model and the Empirical Bayes Beamformer algorithm, precise brain source reconstruction is achieved. By deriving current source density (CSD) of laminar source signals, this framework facilitates the identification of current sinks and sources, enabling in-depth analysis of neural dynamics across cortical layers. A model integrating distance from MEG sensors and brain anatomy predicts accurate and precise cortical neural activity locations. This project demonstrates hpMEG's sensitivity to cortical column orientation, aiming to establish MEG as a powerful tool for non-invasively determining precise cortical layer activity. The implications extend to advancing the understanding of brain function in health and disease, bridging macro-scale observations in humans with micro-circuit activity in animal models.
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