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Physics-Model-Integrated Pipeline for Resolution-Generalized AI in MRI

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Although deep learning has greatly advanced MRI, these methods often face challenges in generalizing across scanners, modalities, and acquisition settings. Imaging resolution, in particular, remains a major obstacle. For example, deep learning-based QSM techniques typically show degraded performance when the test data resolution does not match that of the training data. Existing attempts to improve resolution generalizability usually involve modifying network structures or tuning parameters, which restricts their use with already trained QSM models. In this presentation, we introduce a novel pipeline that allows pre-trained QSM networks to process local field maps with varying resolutions. The pipeline consists of four main steps: first, the input local field map is resampled at multiple spatial offsets to create several versions at the network's trained resolution. Each resampled map is then passed through the network to reconstruct QSM maps. These outputs are subsequently merged, followed by a "dipole compensation" step to correct systematic errors arising from resampling and combination. This approach offers a practical strategy for extending the resolution generalization of pre-trained QSM networks, thereby broadening their utility in clinical practice.

Keywords: *Deep learning, Resolution, Generalization*