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# When Data is Scarce and Labels are Noisy: Meta-Reweighing Learning for Brain Tumor Segmentation

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Deep learning has driven remarkable progress in medical image segmentation, yet its success often hinges on access to large, accurately annotated datasets. In practice, however, annotations may be noisy—due to human error, varying expertise, or inconsistent labeling protocols—and data scarcity remains common, particularly for rare conditions or underrepresented populations such as pediatric and African brain tumor cases. Noisy labels can mislead the learning process by introducing incorrect gradient updates, while domain differences between datasets may further degrade model performance.

In this talk, I will present MGR-DAS (Meta-Gradient Reweighting via Direction-Aware Similarity), a meta-learning-based approach designed to improve segmentation robustness in the presence of label noise and limited training data. The method leverages a small, clean subset—easy to curate from the available dataset—to guide adaptive reweighting of training samples based on gradient similarity. By prioritizing samples with gradients aligned to the clean subset, MGR-DAS mitigates the effect of noisy labels, enhances generalization, and better handles cross-population variations.

I will discuss the motivation behind the approach, its key algorithmic components, and its evaluation across adult, pediatric, and African brain tumor segmentation tasks. Results demonstrate that MGR-DAS consistently improves segmentation quality over conventional fine-tuning, curriculum learning strategies, and existing meta-learning frameworks, even when only a handful of clean annotations are available.

*Keywords:* *Meta-Learning, Gradient Similarity, Label Noise, Data Scarcity, Brain Tumor Segmentation*