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Research Abstracts

Black-Box Adaptation for Medical Image Segmentation

Jay Nitin Paranjape; Shameema Sikder, MD, FACS; S. Swaroop Vedula, MBBS, PhD, MPH; and Vishal M. Patel

Johns Hopkins University, Baltimore, MD; Johns Hopkins University School of Medicine, Baltimore, MD

Introduction: Large foundation models have advanced image segmentation in general computer vision tasks, but they often underperform in medical image segmentation due to being trained on non-medical data. Current methods for adapting these models to medical tasks usually assume full access to model parameters, which is not always feasible since many models are available only as APIs or black boxes. Additionally, fine-tuning such models can be computationally intensive, and privacy concerns restrict sharing medical data with third parties.

Methods: To address these challenges, we propose BAPS (Black-Box Adaptation for Prompted Segmentation), a novel technique designed for the adaptation of foundation models in medical image segmentation under black-box conditions. BAPS consists of two components: an Image-Prompt Decoder (IP Decoder) that generates visual prompts from input images and prompts, and a Zero Order Optimization (ZOO) method, SPSA-GC, which updates the IP Decoder without backpropagating through the foundation model. This method allows adaptation without knowledge of the model's weights or gradients, making it ideal for black-box scenarios.

Results: BAPS was tested on four different medical imaging modalities, demonstrating an approximate 4% improvement in the original foundation model's performance. This improvement was achieved without any direct interaction with the foundation model's internal parameters, highlighting the effectiveness of our black-box adaptation approach.

Conclusions: BAPS provides an innovative solution for adapting foundation models to medical image segmentation, particularly when model parameters are inaccessible. By combining an Image-Prompt Decoder with a Zero Order Optimization method, BAPS effectively improves segmentation performance without requiring access to the model's internal structure. This approach addresses key challenges in computation and privacy, offering a new pathway for the application of foundation models in medical imaging. The code for BAPS is publicly available.