

Optimized U-Net Architecture with Residual and Attention Blocks for Multi-Class Tumor Segmentation

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This study presents an enhanced U-Net model incorporating residual blocks and attention gates to improve multi-class tumor segmentation using four MRI modalities on the BraTS 2020 challenge dataset. Unlike binary tumor versus background approaches, our pipeline generates a four-class map in a single pass, thereby providing a markedly more detailed anatomical description: GD-enhancing tumor (ET, label 4), peritumoral oedema (ED, label 2), necrotic/non-enhancing tumor core (NCR/NET, label 1) and background healthy tissue (label 0). The network adopts a hybrid focal Tversky loss that simultaneously mitigates class imbalance and rewards accurate spatial overlap, while dropout and weight-decay regularisation accelerate stable convergence. Structurally, it contains three encoder-decoder levels with progressively wider channels and a 256-filter bottleneck, a configuration that preserves fine spatial detail yet captures rich semantic context.

References

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