High-resolution image segmentation with U-Net-based segmentation CNN on multiple GPUs

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We introduce a novel approach (see Figure 1) for segmenting high-resolution images across multiple GPUs, by combining the U-Net architecture with domain decomposition strategies. Our approach partitions high-resolution input images into non-overlapping patches, each stored and processed independently on different GPUs. A communication network facilitates global communication across subdomains, using deep, encoded feature maps, leading to minimal memory overhead.

Our method makes it possible to process high-resolution images across multiple GPUs without losing detailed contextual information or sacrificing global information from other patches. In contrast, the memory overhead due to communication is minimal. Extensive evaluation across diverse datasets, including synthetic data, Inria Aerial Images, and DeepGlobe Satellite Segmentation Dataset, demonstrates good performance compared to the baseline U-Net, particularly in consistently accurate class predictions along boundaries.