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Lightweight Context-Aware Network Using Partial-Channel Transformation for Real-Time Semantic Segmentation

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Abstract

Optimizing the computational efficiency of the artificial neural networks is crucial for resource-constrained platforms like autonomous driving systems. To address this challenge, we proposed a Lightweight Context-aware Network (LCNet) that accelerates semantic segmentation while maintaining a favorable trade-off between inference speed and segmentation accuracy in this paper. The proposed LCNet introduces a partial-channel transformation (PCT) strategy to minimize computing latency and hardware requirements of the basic unit. Within the PCT block, a three-branch context aggregation (TCA) module expands the feature receptive fields, capturing multiscale contextual information. Additionally, a dual-attention-guided decoder (DD) recovers spatial details and enhances pixel prediction accuracy. Extensive experiments on three benchmarks demonstrate the effectiveness and efficiency of the proposed LCNet model. Remarkably, a smaller model LCNet(3_7) achieves 73.8% mIoU with only 0.51 million parameters, with an impressive inference speed of similar to 142.5 fps and similar to 9 fps using a single RTX 3090 GPU and Jetson Xavier NX, respectively, on the Cityscapes test set at 1024 x 1024 resolution. A more accurate version of the LCNet(3_11) can achieve 75.8% mIoU with 0.74 million parameters at similar to 117 fps inference speed on Cityscapes at the same resolution. Much faster inference speed can be achieved at smaller image resolutions. LCNet strikes a great balance between computational efficiency and prediction capability for mobile application scenarios. The code is available at <https://github.com/lztjy/LCNet>.

Keywords

Author Keywords: [Semantic segmentation](#); [Convolution](#); [Computational modeling](#); [Feature extraction](#); [Real-time systems](#); [Stacking](#); [Semantics](#); [Real-time semantic segmentation](#); [partial-channel transformation](#); [context-aware aggregation](#); [reverse attention](#); [spatial attention](#)

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