SGENet: Spatial Guided Enhancement Network for Image Motion Deblurring

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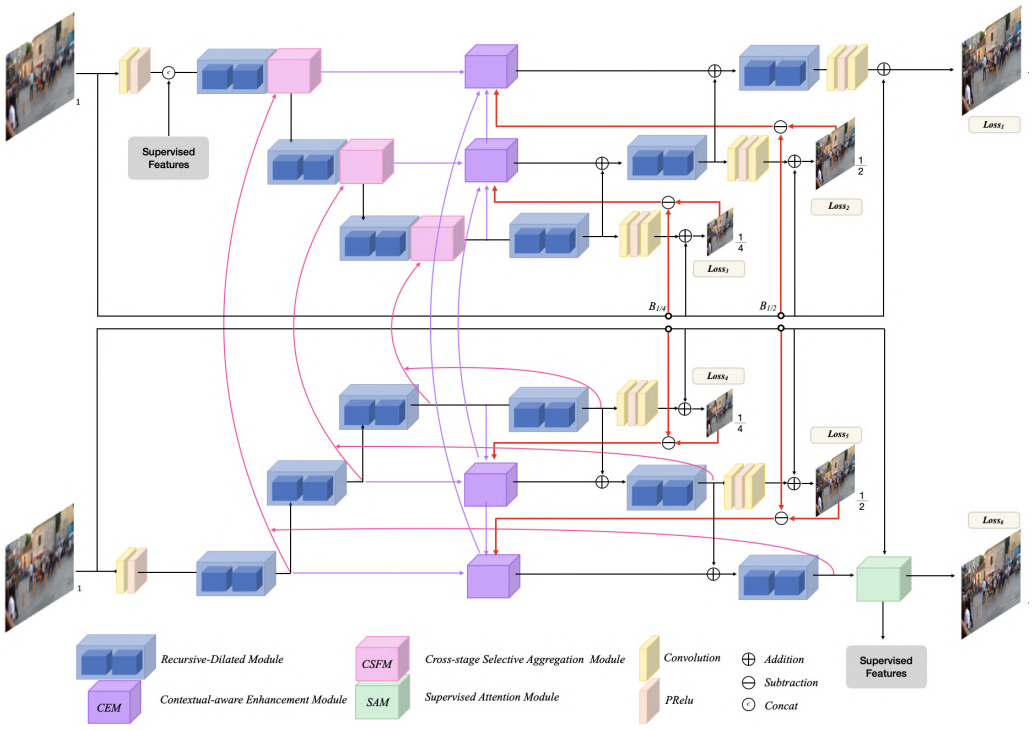
Abstract

Multi-stage architectures have been widely used for image motion deblurring and achieved significant performance. Previous methods restore the blurred image by obtain- ing the spatial details of the blurred input image. However, the blurred image cannot provide accurate high-frequency details, degrading the overall deblurring performance. To address this issue, we propose a novel dual-stage architecture that can fully extract the high-frequency information of the blurred images for reconstructing detailed tex- tures. Specifically, we introduce a supervised guidance mechanism that provide precise spatial details to recalibrate the multi-scale features. Furthermore, an attention-based fea- ture aggregator is proposed to adaptively fuse influential features from different stages in order to suppress redundant information from the earlier stage passing through to the next stage, allowing efficient multi-stage architecture design. Extensive experiments on GoPro and HIDE benchmark datasets show the proposed network has the state-of-the- art deblurring performance with low computational complexity when compared to the existing methods.

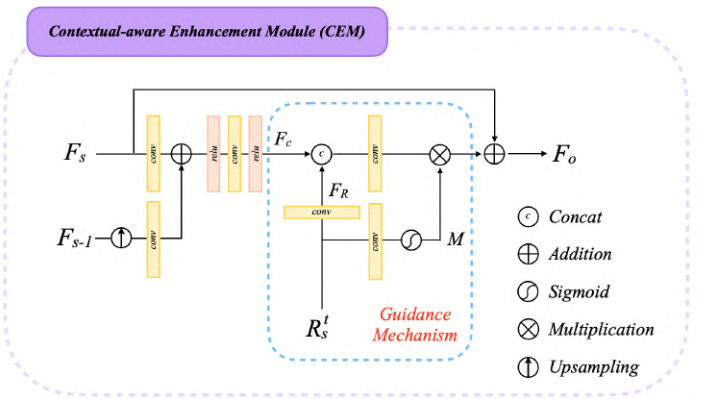
Network Architecture

A schematic of the proposed SGENet is shown in following figure, which consists of two encoderdecoder sub-networks for restoring blurred images. First, a dilated convolution module is added with a recursive residual design to extract multi-scale features. Second, the feature maps at U-Net skip connections are processed with the proposed CEM, which is capable of synthesizing the detailed texture of the restored image. Finally, instead of simply stacking multiple stages, we incorporate a cross-stage selective aggregation module between the two stages, which can adjust the weights of different sub-networks adaptively to select useful feature representations.



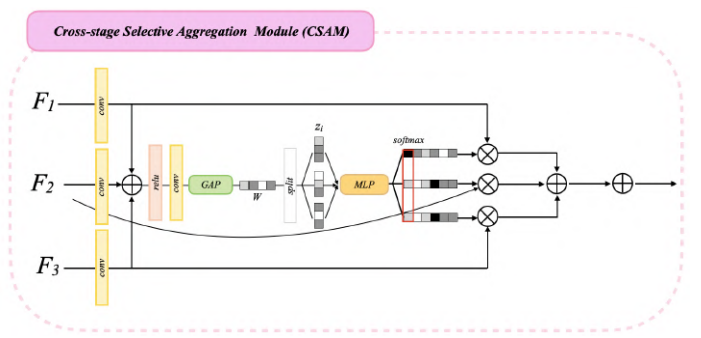
Contextual-aware Enhancement Module (CEM)

The guided mechanism can fully exploit the high-frequency information from the predicted image to precisely generate outputs with detailed texture.



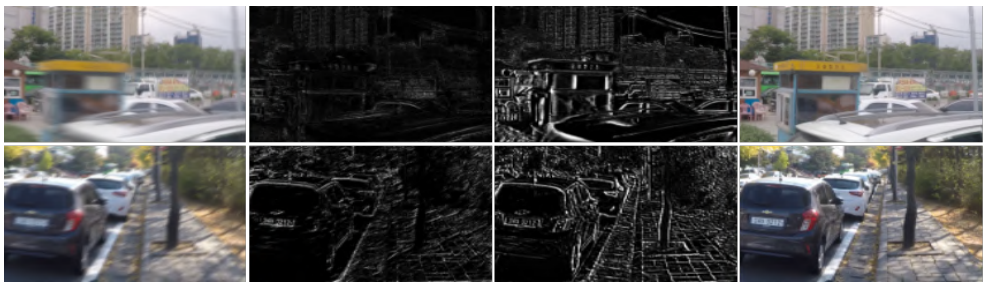
Cross-stage Selective Aggregation Module (CSAM)

The aggregation strategy can adjust the receptive field to suppress the redundant information and pass only useful semantic features to the next stage.



Result

It can be observed that the results of other methods still suffer from local region blurring and even producing ringing artifacts, which destroy the original image contents. In contrast, our method generates the most comparable results to the ground truth images, and our restored images can well recover the global structure and the sharper detailed textures.



Conclusion

This paper proposes a novel spatial guidance enhancement network for single image de- blurring, which aims at restoring blurred images with accurate spatial details. We develop the guidance mechanisms to progressively rebuild images by fully exploiting precise high- frequency information of predicted images. We require these high-level features with flex- ible information exchange across different stages. To this end, we propose a cross-stage selective aggregation strategy to adaptively utilize useful feature representations for an effi- cient multi-stage architecture. Experimental results show the proposed method achieves the state-of-the-art restoration performance with low time complexity when compared with the existing methods on two benchmark datasets.

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