MHF-net with CBAM

A novel method developed for generating high resolution Multispectral Image using a sequential K-staged network with attention modules appended between layers.

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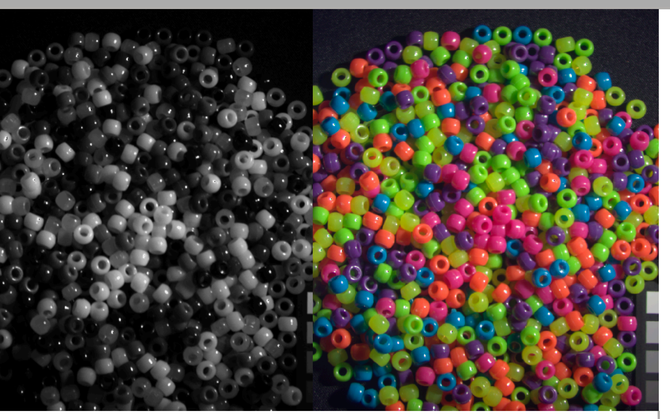


01. Problem Statement

Hyperspectral imaging provides a deeper understanding of different materials' characteristics than traditional imaging systems can offer. However, in practice, only high-resolution multispectral (HrMS) images and low-resolution hyperspectral (LrHS) images can typically be captured at video rates.

02. Objective

The objective is to generate high resolution Multispectral Image using efficiently using the proposed MHF-net in the original paper, along with appending some Channel and spatial attention blocks in some of the layers.

Since attention modules can greatly inhance the feature representation across channels and different features such as edges, this method is expected to enhance the final result in the original paper.

03. Methodology

The original proposed algorithm is K staged fusion network following the algorithm given below.

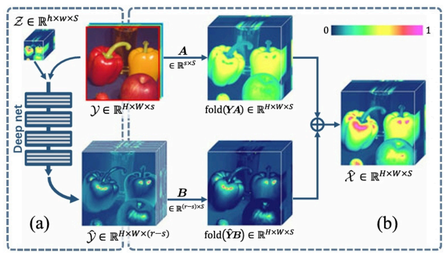
$$\mathcal{X}^{(k)} = \mathcal{Y} \times_3 \boldsymbol{A}^T + \hat{\mathcal{Y}}^{(k)} \times_3 \boldsymbol{B}^T \quad \boldsymbol{S_k}$$

$$\mathcal{E}^{(k)} = \text{downSample}_{\theta_d^{(k)}}\left(\mathcal{X}^{(k)}\right) - \mathcal{Z}$$

$$\mathcal{G}^{(k)} = \eta \cdot \text{upSample}_{\theta_u^{(k)}}\left(\mathcal{E}^{(k)}\right) \times_3 \boldsymbol{B}$$

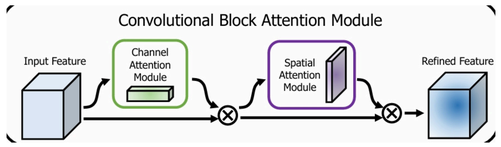
$$\hat{\mathcal{Y}}^{(k+1)} = \text{proxNet}_{\theta_p^{(k)}}\left(\hat{\mathcal{Y}}^{(k)} - \mathcal{G}^{(k)}\right)$$

Where X^k is the output of kth stage,.



04. Attention Module

The attention module consists of two different modules, namely Channel attaention and Spatial attention.



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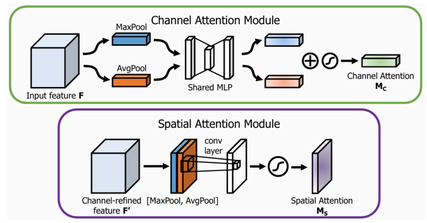


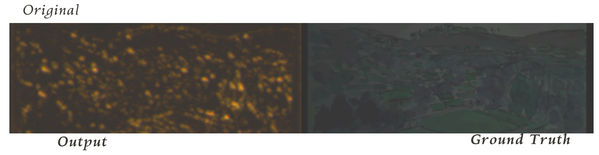
05. Result Analysis

The following results are obtained with 4 different methods, original being the original method described in the paper, cbam(n) being methods involving different number of attention modules

Model	Training loss value	Valid loss value	PSNR ranges	SSIM ranges
Original-paper	0.0140	0.0208	10-14	0.94-0.98
CBAM1	0.0137	0.0158	11-16	0.98-0.99
CBAM2	0.0178	0.0486	9-15	0.98-0.99
CBAM3	0.0170	0.0339	11-14	0.96-0.97

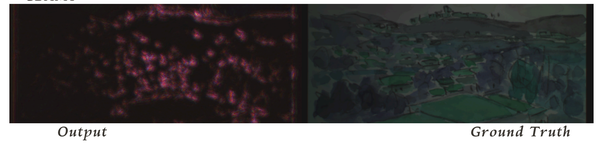
06. Image Results

Original



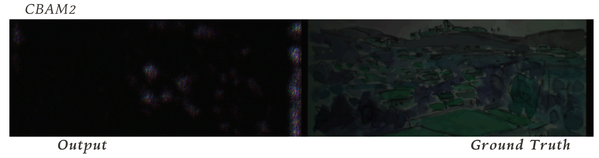
Output *Ground Truth*

CBAM1



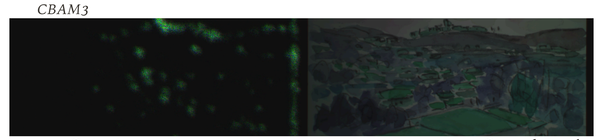
Output *Ground Truth*

CBAM2



Output *Ground Truth*

CBAM3



Output *Ground Truth*

06. Conclusion

Adding attention modules to the original model helps the network better focus on critical features like edges, as observed in the image results. However, careful consideration is required, as too many attention modules can lead to poorer results and increased computational

Papers referred

Multispectral and Hyperspectral Image Fusion by MS/HS Fusion Net

MHF-Net: An Interpretable Deep Network for Multispectral and Hyperspectral Image Fusion

CBAM: Convolutional Block Attention Module