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Learning-Based Hyperspectral Image Compression Using A Spatio-Spectral Approach

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Advances in hyperspectral imaging have led to a significant increase in the volume of hyperspectral image archives. Therefore, the development of efficient and effective hyperspectral image compression methods is an important research topic in remote sensing. Recent studies show that learning-based compression methods are able to preserve the reconstruction quality of images at lower bitrates compared to traditional methods [1]. Existing learning-based image compression methods usually employ spatial compression per image band or for all bands jointly. However, hyperspectral images contain a high amount of spectral correlations which necessitates more complex compression architectures that can reduce both spatial and spectral correlations for a more efficient compression. To address this problem, we propose a novel Spatio-Spectral Compression Network (S2C-Net).
S2C-Net is a flexible architecture to perform hyperspectral image compression, exploiting both spatial and spectral dependencies of hyperspectral images. It combines different spectral and spatial autoencoders into a joint model. To this end, a learning-based pixel-wise spectral autoencoder is initially pre-trained. Then, a spatial autoencoder network is added into the bottleneck of the spectral autoencoder for further compression of the spatial correlations. This is done by applying the spatial autoencoder to the output of the spectral encoder and then applying the spectral decoder to the output of the spatial autoencoder. The model is then trained using a novel mixed loss function that combines the loss of the spectral and the spatial model. Since the spatial model is applied on the output of the spectral encoder, the spatial compression methods that are optimised for 2D image compression can be used in S2C-Net in the context of hyperspectral image compression.
In the experiments, we have evaluated our S2C-Net on HySpecNet-11k that is a large-scale hyperspectral image dataset [2]. Experimental results show that S2C-Net outperforms both spectral and spatial state of the art compression methods for

bitrates lower than 1 bit per pixel per channel (bpppc). Specifically, it can achieve lower distortion for similar compression rates and offers the possibility to reach much higher compression rates with only slightly reduced reconstruction quality.

References

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