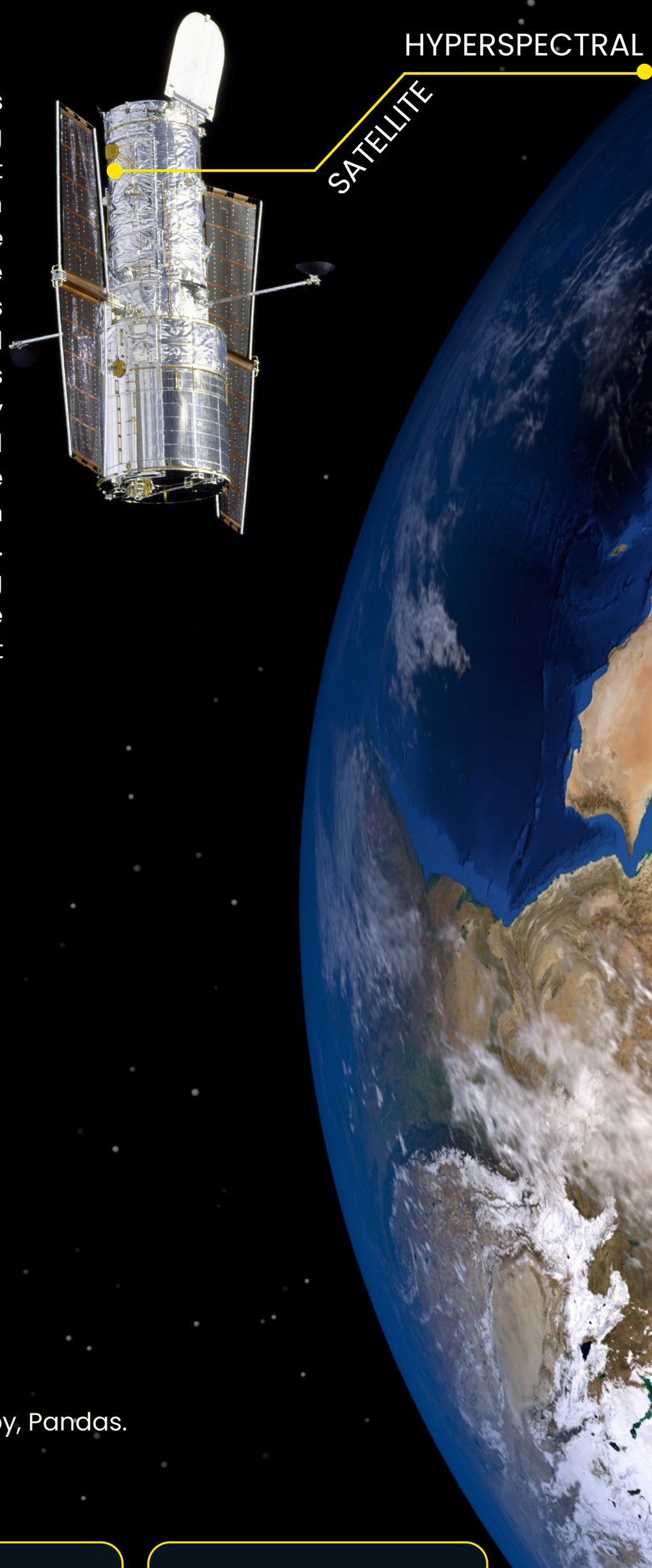
NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES PESHAWAR

HYPERSPECTRAL IMAGE DENOISING

ATTENTION AND ADJACENT FEATURES WITH HYBRID DENSE NETWORK

ABSTRACT

The performance of high-level semantic tasks in hyperspectral images (HSIs) is often unsatisfactory due to the complexity of the imaging environment, corruption, and degeneration. These factors result in different types of noise in HSIs. Although natural image denoising methods have been successful, existing CNN-based HSIs denoising methods continue to face the challenge of inadequate noise suppression and insufficient feature extraction. Therefore, there is still significant room for improvement in this field. To address these challenges, a novel HSIs denoising algorithm based on Attention and Adjacent Features - Hybrid Dense Network (AAFHDN) has been proposed. This algorithm is capable of decomposing high-frequency features, preserving geometrical characteristics as structure prior, and extracting band correlation of the adjacent spatial and multiscale separable spectral features. The effectiveness of the proposed method has been evaluated through experiments on simulated and real-world noisy images. The results demonstrate that the AAFHDN algorithm outperforms existing traditional methods in both quantitative evaluations and visual effects. The improved denoising performance of the proposed method can benefit subsequent classification and target detection tasks in HSIs.



OBJECTIVE

To invent a novel HSIs denoising network, that utilizes the features of spectral band correlation, and geometrical characteristics, and decomposes high-frequency features. To extract adjacent spatial and multiscale separable spectral features, suppress global frequency noise levels, and preserve real HSIs spatial-spectral information structure prior. To perform well-constructed results than other proposed HSIs methods. To relatively low runtime complexity, robust, flexible, and cost-effective network.

PRACTICAL APPLICATION

The utilization of the AAFHDN application in remote sensing and geoscience industrial settings serves the purpose of reducing noise from hyperspectral images while simultaneously maintaining the integrity of the well-established classification and target detection data.

TECHNOLOGIES

IDE: Google Colaboratory, Visual Studio Code.
Framework: Pytorch, Django, NodeJS
API: Pytorch Lightning, Tensorflow, Keras, Scikit-Learn, Numpy, Matplotlib, Scipy, Pandas.

SYSTEM DESIGN

01 HYPERSPECTRAL IMAGE
- Data Preprocessing for Simulated and Real Experiments

02 TRAIN AND TEST MODULE
- Noise and Clean splitted data of Spatial-Spectral.

03 SPECTRAL BANDS CORRELATION
- Noisy and K-Adjacent Bands Image

04 GEOMETRICAL CHARACTERISTICS
- Multiscale Separable Features Extraction

05 DECOMPOSE FREQUENCY (HIGH AND LOW)
- Attention Modules and Denoiser Network

06 NOISE IMAGE FEATURES
- Noise Bands Features Collection and Substitution

07 CLASSIFICATION AND TARGET DETECTION
- Efficient Denoise Results Predictions

08 SIMULATED AND REAL RESULTS EVALUATION
- Quantitative and Qualitative Evaluation

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