SVD
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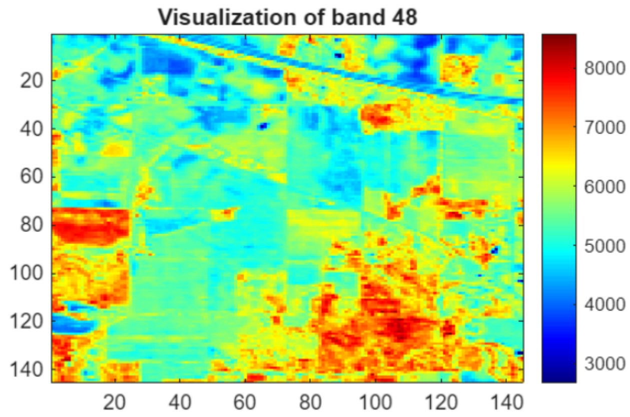
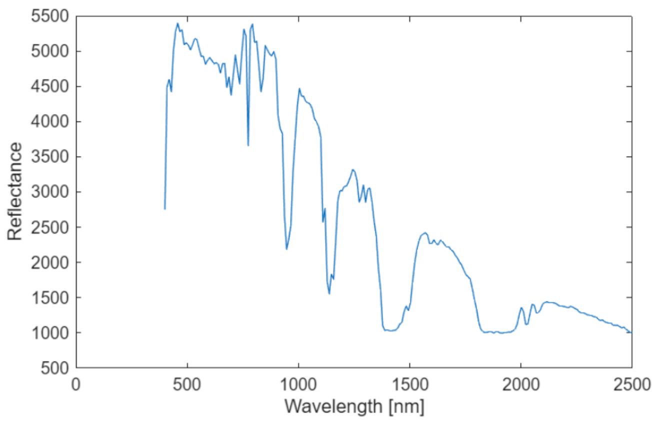
The hyperspectral dataset Indian Pines was loaded and visualized:

An RGB image was generated using selected bands, and one spectral band was displayed in false color:

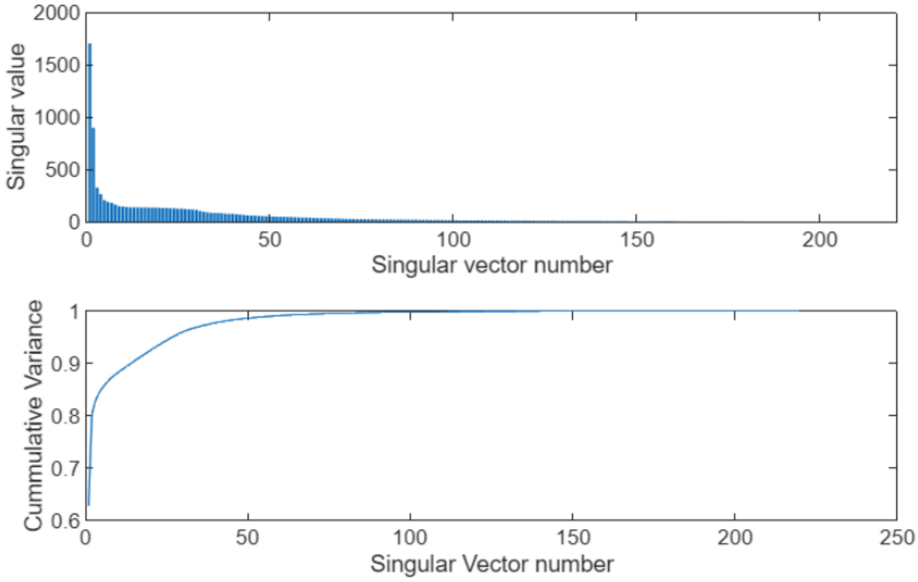


The reflectance spectrum of a chosen pixel was plotted to illustrate spectral variation:



The 3D data cube (145 × 145 × 220) was reshaped into a 2D matrix of size (rows × columns) × wavelengths. Singular Value Decomposition (SVD) was performed on the reshaped matrix after normalization.

When defining the reconstruction rank, the variances were calculated by squaring the singular values. Cumulative variance was calculated by dividing cumulative sum by 'normal' sum of variances. The expression produces a vector showing how much of the total variance is explained by each singular value, which makes it possible to identify the number of components required to exceed a chosen threshold, such as 95%.



Based on this analysis, a rank of 27 was chosen, as it captured over 95% of the variance. The data was then reconstructed using the truncated matrices, significantly reducing dimensionality.

The Root Mean Squared Error (RMSE) between the original and reconstructed data was calculated by taking means for each pixel across all spectral bands. As a result, a 145x145 matrix was created which had the pixel-specific average errors. A false-color visualization of the reconstruction error showed that the errors seem to be systematically located in areas where the original image has more detail, contrast, or unusual features (e.g., field boundaries, roads, shadows) or individual 'noise pixels'.