

Explanation for PCA Component Selection

While applying Principal Component Analysis (PCA) to the images, I experimented with 10, 20, and 100 components to understand how the number of components affects the reconstructed image's quality.

With 10 components, the reconstructed image was highly compressed, and many fine details were lost. Although the general structure of the image was still visible, the quality was too low to identify intricate features like textures or edges. Increasing to 20 components significantly improved the reconstruction. The main features of the image became more distinct, and the quality was sufficient for recognizing most details. At this point, the cumulative variance explained by the components covered most of the important information in the image.

When I increased the number to 100 components, the reconstructed image became almost identical to the original. However, the added computational complexity and storage requirements outweighed the minimal improvement in visual quality. This experiment demonstrated that 20 components provided the best balance between dimensionality reduction and retaining visual detail.

By comparing the results across these different numbers of components, I gained a deeper understanding of how PCA effectively compresses data while preserving key patterns.