Data and Image Compression with Discrete Wavelet and Cosine Transforms

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Background

A Citadel Foundation grant was obtained to support a one year student research project to investigate signal compression techniques. This work also met the curriculum requirements for The Citadel's Honors Program.

Data and image compression is of interest to a wide variety of entertainment, business and scientific endeavors. Signal compression of data reduces digital storage requirements and enhances speed of transmission. Although many data compression algorithms can be found in the literature, this research paper focusses on a comparison of the advantage of one linear transform over another. We have compared the ability of the discrete wavelet transform (DWT), and the discrete cosine transform (DCT) to condense the signal information.

Purpose

The purpose of this research is to investigate and compare the discrete wavelet and cosine transforms for signal compression. This is done in order to assess the compression advantages of using one transform over the other before the implementation of encoding and decoding algorithms.

Design/Method

This paper applied wavelet-based signal and image compression techniques to synthetic signals, and extended these methods to the discrete frequency domain using the DCT. MATLAB software was used to analyze short synthetic signals and images. Each signal or image was transformed using the discrete wavelet and cosine transforms, then recursive simulations compared compression efficiency of the transforms.

Results

The original and the compressed versions of the signals are shown for comparison. The peak signal to noise ratio (PSNR), and the signal entropy were calculated to measure the performance of the compression using each transform.

Conclusions

The transform that represented the signals with the fewest number of significant transform coefficient data points (i.e., with the least entropy), were found to performed the best. Future work will be conducted using more complex signals such as audio, communication signals, and medical images.