Transmitting, Compressing, and Denoising Images
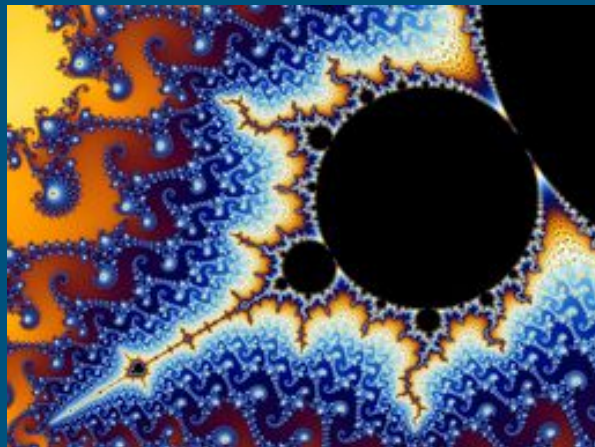
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Overview

- Denoising data

- Data compression

Transmitting data and Images

- Data sent by itself can be corrupted and pieces can be completely lost

- Can "over-send" the data through the use of a Parseval frame

- This way, the frame coefficients could get corrupted, but the changes made to the data are smaller (more diluted).

Method

Dealing with data corruption with and without a frame and compare both to original data

- $$d = \sum_{i=1}^{N} \langle d, F_i \rangle F_i$$

- Where d is the data, F is the frame, N is the number of elements in the frame

- Corrupt a percent of the frame coefficients using the normal distribution

- $$\hat{d} = \sum_{i=1}^{N} \widehat{\langle d, F_i \rangle} F_i$$

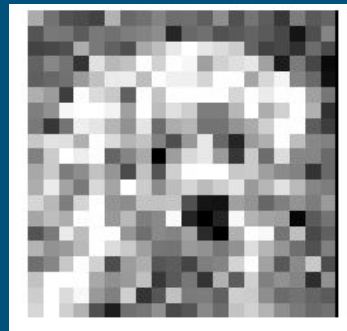- d hat is corrupt data received from corrupt coefficients

Results

Original Image
(20 x 20)

C1: Corruption without a
frame
Error: 4.2356

C2: Corruption with a
frame
Error: 3.3337

The error was calculated using the norm of the difference between
the corrupt image and the original, so the smaller, the better.

Compressing Data

- Storage is limited, how to store less? - Data compression

- Fourier Discrete Cosine Transform (DCT) Matrix dotted with image data gives Fourier coefficients

- Fourier coefficients are organized by low to high frequency with the bigger numbers at the start and smaller at the end.

- The end numbers correlate to miniscule details in the image and without them our eyes will barely discern a difference.

Method

- Fourier DCT Matrix dotted with image data

- Keep only a percent of the Fourier coefficients, set the rest (at the end) to zero

- Would only have to store the non-zero Fourier coefficients

- Inverse/Transpose Fourier DCT Matrix to get back to the image data (slightly altered)

Results

Original Image
(100 x 100)

Compressed
Image (using
only 80% of
coefficients)

Error: 46.53

Denoising Data
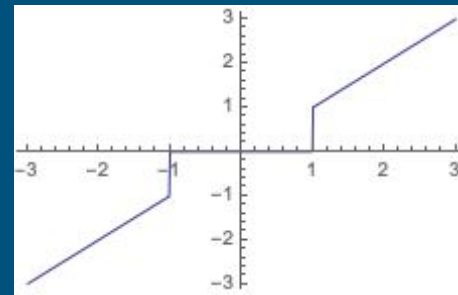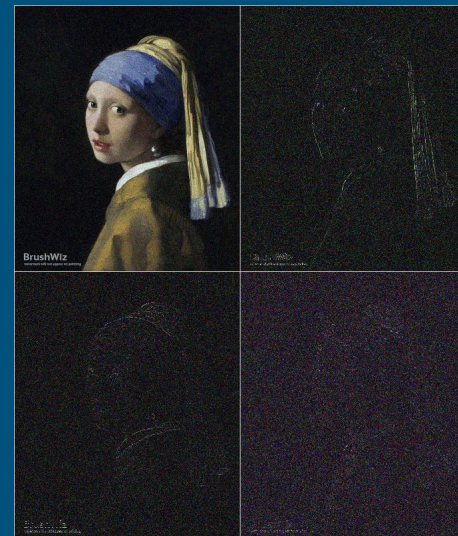
- Data can be corrupted with noise

- Use wavelets to smooth or denoise data

Method

- Take the discrete wavelet transform of the image or data

- Threshold the discrete wavelet transform

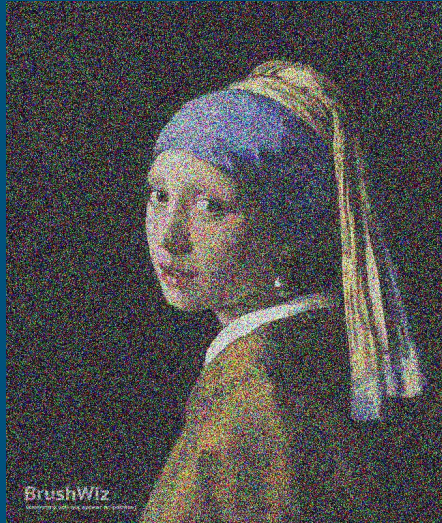- Take the inverse wavelet transform of the thresholded data

Results

Original

Noised

Denoised

Thanks!