Image Steganograpy using Wavelet Transform

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DS601 - Digital Image Processing - Dr. Nitin Khanna

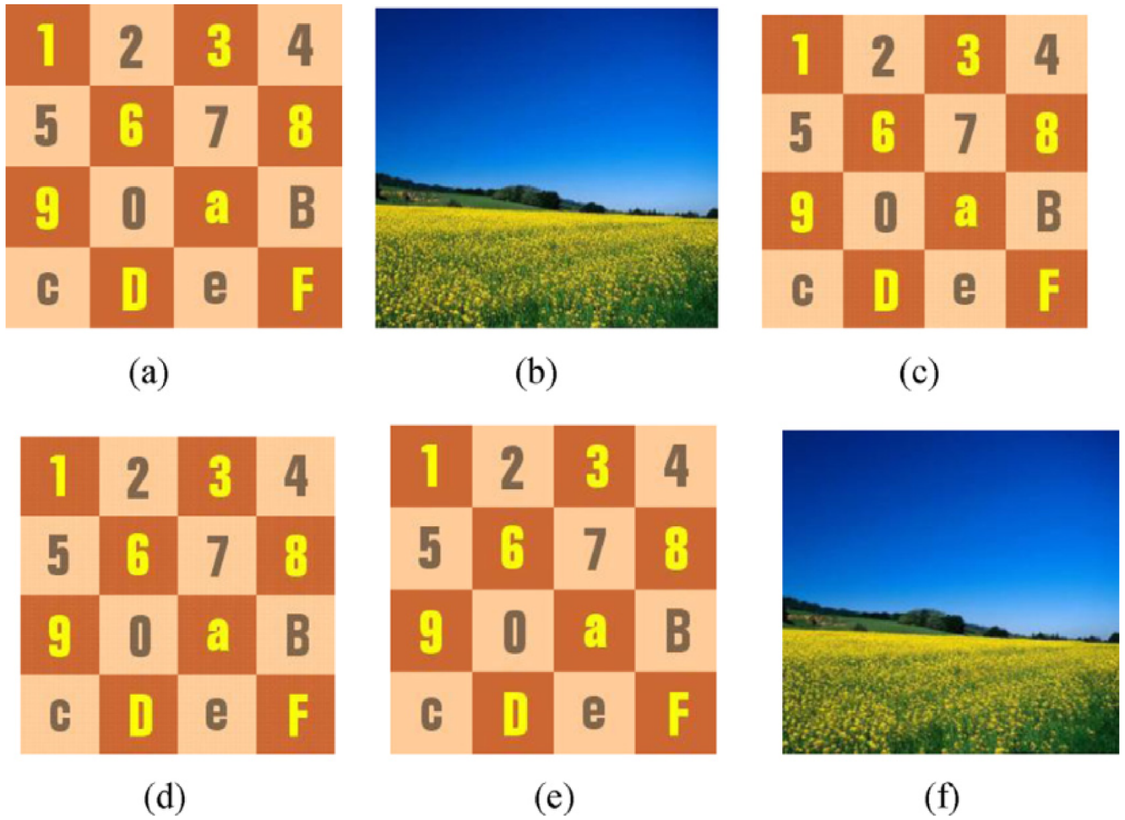
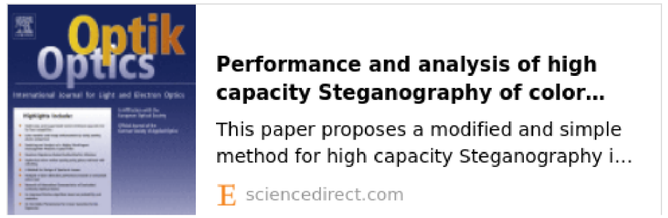


Fig. 8. MATLAB simulation (a) cover image; (b) payload image; (c) stego image (embedded image); (d) stego image; (e) cover image; (f) payload image (extracted).

Image Steganography

Steganography is like a secret way of sharing information. It's a bit like hiding a treasure in plain sight. Instead of using complicated codes or passwords, it sneaks messages by blending them with ordinary things, like pictures or music. So, it's a clever way of communicating without anyone knowing there's a hidden message.



Wavelet Transform

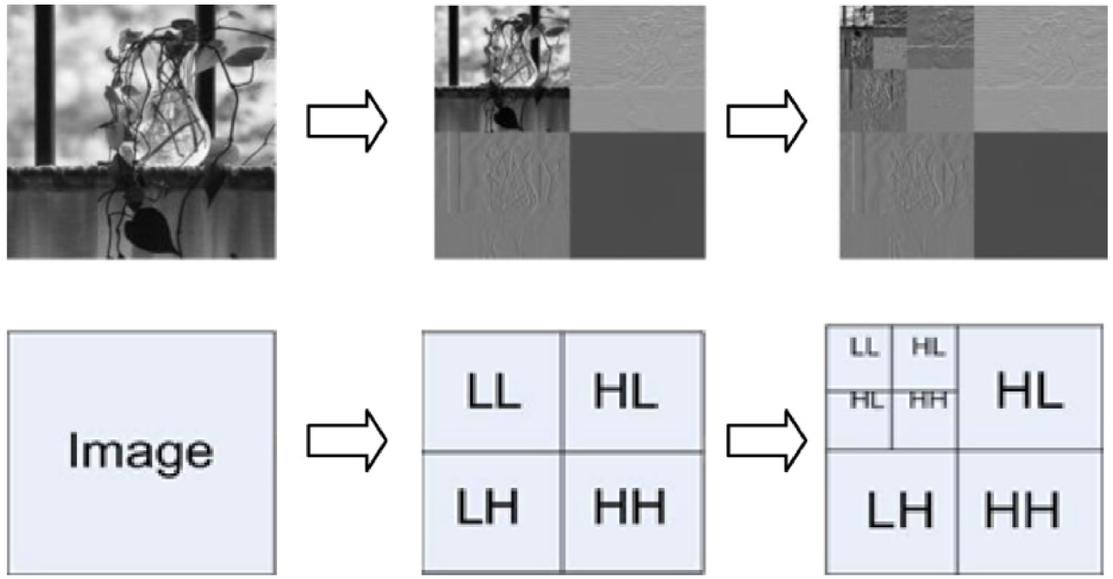


Fig. 2. 2D Wavelet Transform.

A wavelet transform is a mathematical tool that decomposes a signal (such as an image) into its constituent parts, which are then represented in different frequency bands. This makes it possible to analyze and process the signal at different levels of detail.

$$\psi(x) \equiv \begin{cases} 1 & 0 \le x < \frac{1}{2} \\ -1 & \frac{1}{2} < x \le 1 \\ 0 & \text{otherwise} \end{cases}$$

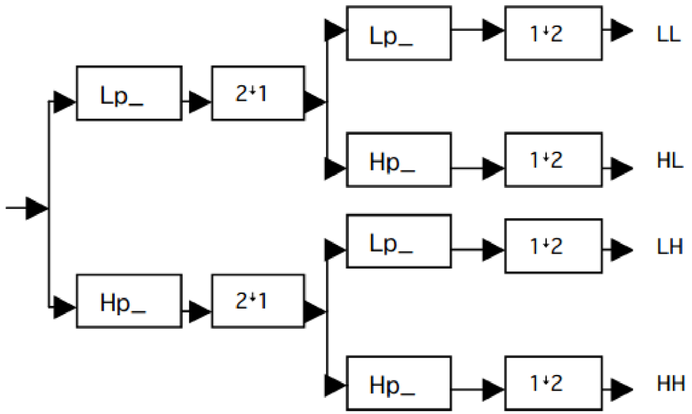
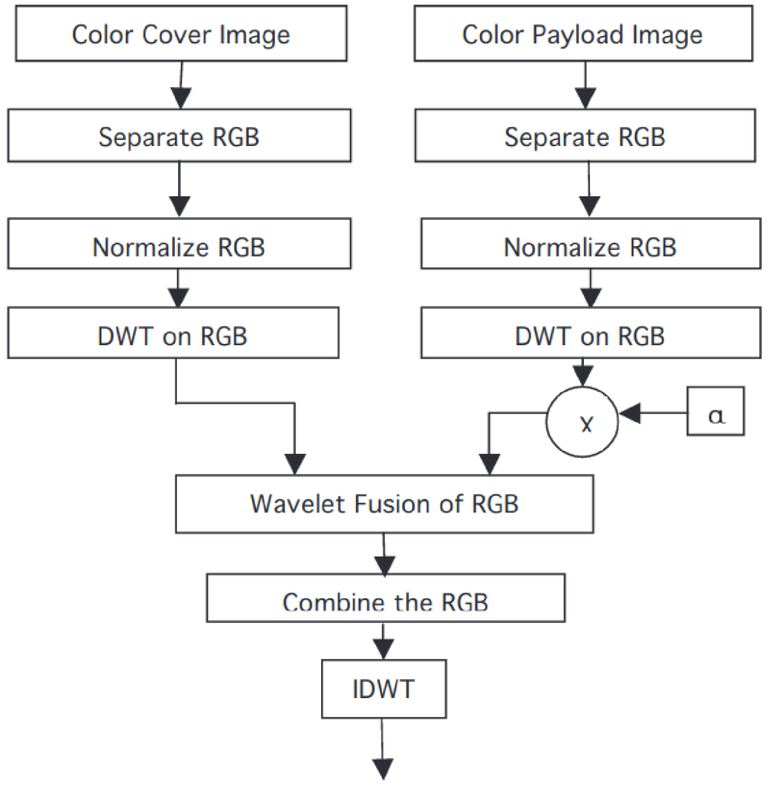
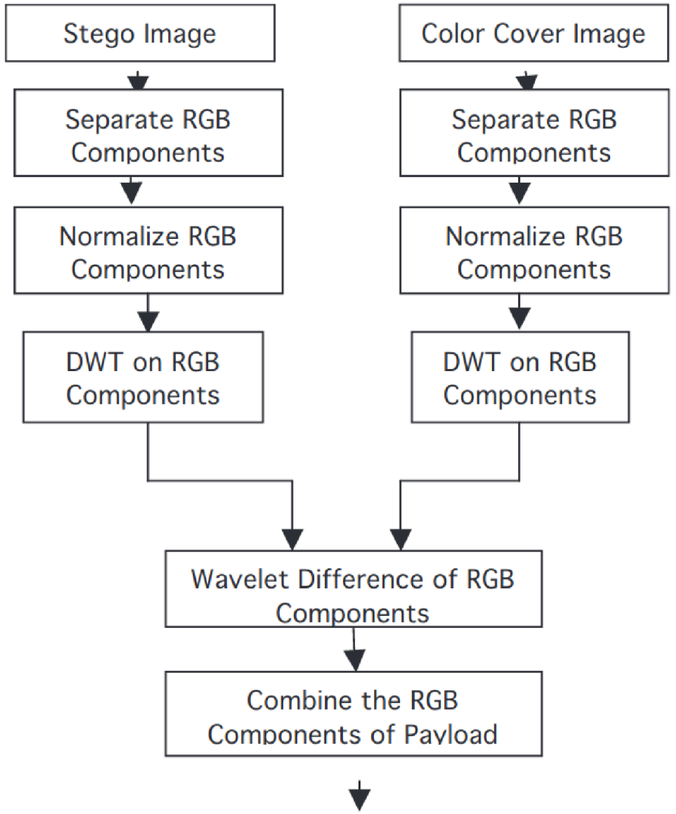


Fig. 1. Filter bank algorithm.

Proposed Algorithm



HCSSD Encodder



HCSSD Decoder

Metrics

MSE:

$$\mathrm{MSE} = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

SNR (Signal-to-Noise Ratio):

$$\mathrm{SNR} = 10\log_{10}\left(\frac{\sigma_x^2}{\sigma_\varepsilon^2}\right)$$

PSNR (Peak Signal-to-Noise Ratio):

$$\mathrm{PSNR} = 10\log_{10}\left(\frac{\mathrm{MAX}_I^2}{\mathrm{MSE}}\right)$$

WPSNR (Weighted Peak Signal-to-Noise Ratio):

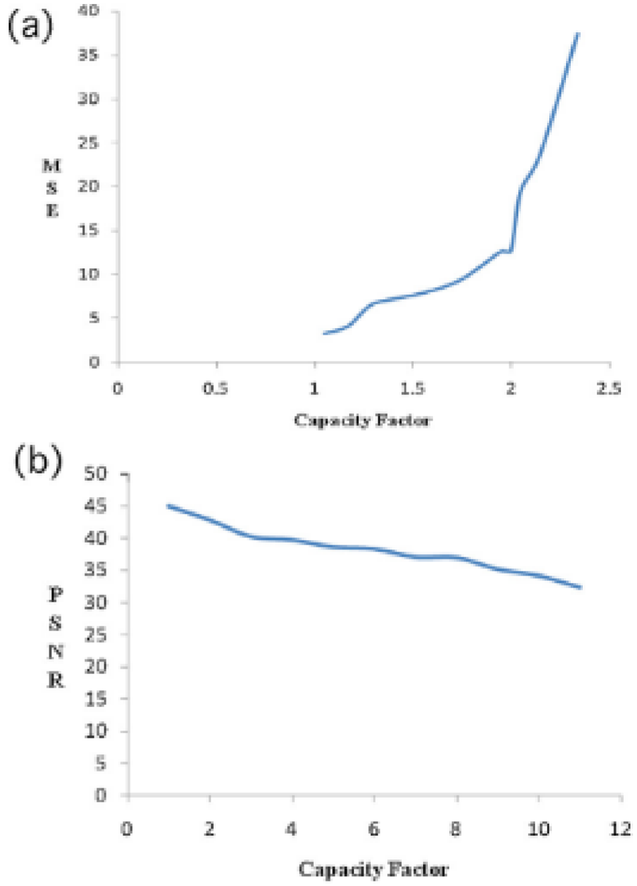
$$\mathrm{WPSNR} = 20\log_{10}\left(\frac{255}{\sqrt{\mathrm{MSE}} \times \mathrm{NVF}}\right)$$

$$\mathrm{NVF} = \mathrm{NORM}\left(\frac{1}{1+\delta^2_{\mathrm{block}}}\right)$$

Structural Similarity Index (SSIM/SC):

$$\mathrm{SSIM}(x,y) = \frac{(2\mu_x\mu_y - c_1)(2\sigma_{xy} - c_2)}{(\mu_x^2 - \mu_y^2 - c_1)(\sigma_x^2 - \sigma_y^2 - c_2)}$$

Histogram Analysis & Plotting



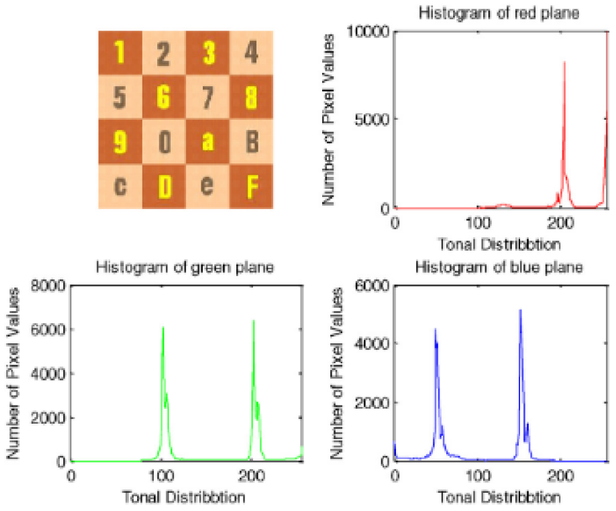


Fig. 10. Histogram of stego image.

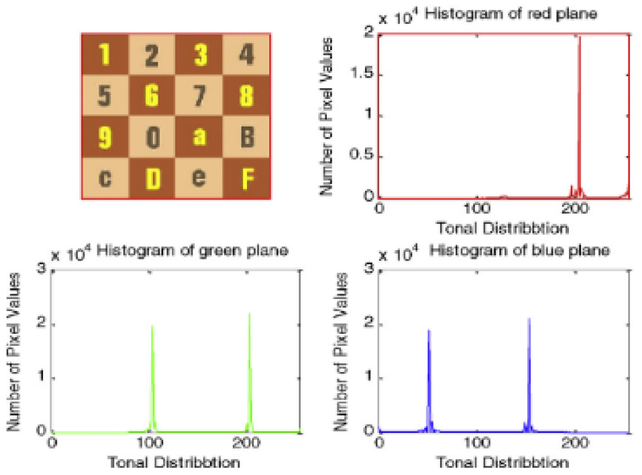


Fig. 6. Histogram plot of cover image.

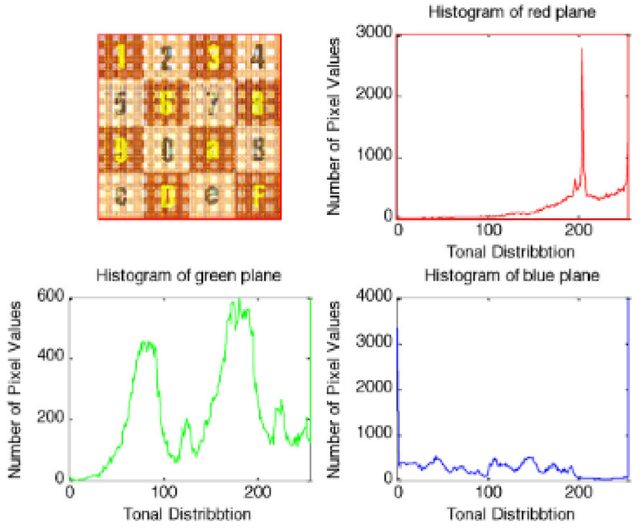


Fig. 7. Histogram plot of stego image.

What We will do in addition

- Apply the Metrics and do the analysis on a curated dataset.
- Apply the algorithm described in the paper on Videos and Performing Analysis.
- Do various image degradation operations like Lossy compression/de-compression. adding noise of various frequencies, masking areas of image etc. and then perform analysis.
- Build a GUI to easily perform the implemented operations selecting any wavelet on any image.

Work Distrbution

G Hemanth

- DWT and IDWT with db1, coif1, sym2.
- HCSSD Decoder
- SSIM, SNR
- GUI

JV Aditya

- DWT and IDWT with DMey, bior1.1
- HCSSD Encoder
- MSE, PSNR
- Histogram Analysis

N Chidvilash

- DWT and IDWT with Haar, rbio1.1
- Pre, Post Processing Steps.
- NVF, WPSNR
- Analysis Plots