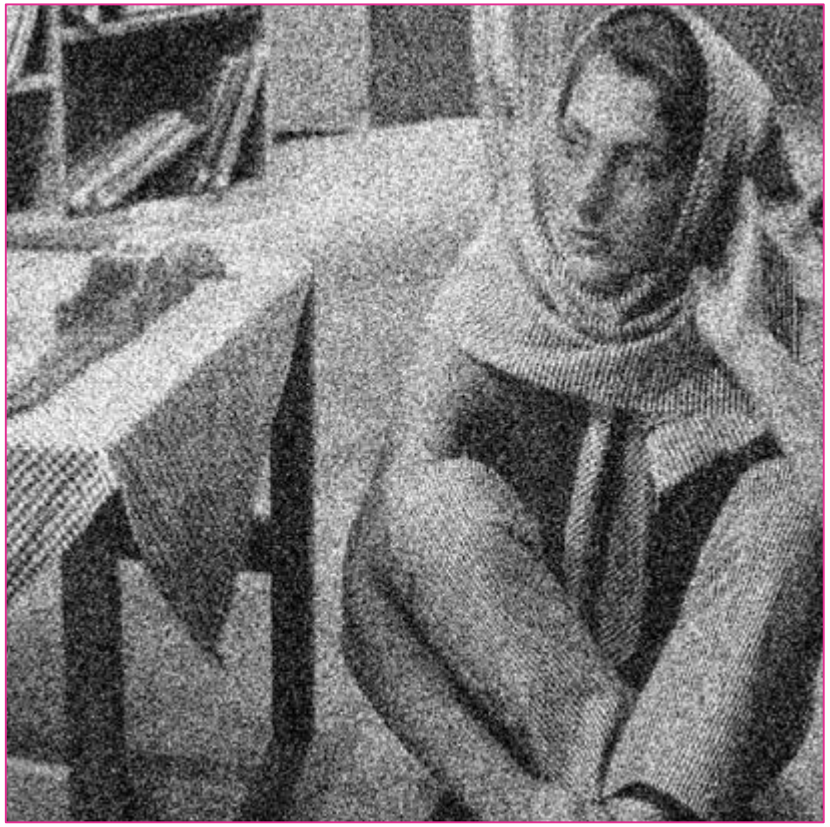
MRA denoising

Dr. Tushar Sandhan

Introduction

Introduction



Wavelet Transform (WT)

- wavelet

$$\psi_{a,b}(t) = \frac{1}{\sqrt{b}}\psi(\frac{t-a}{b})$$

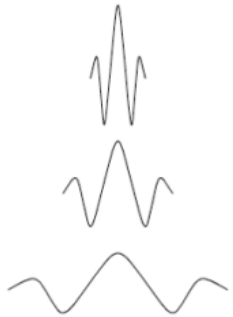
- decomposition

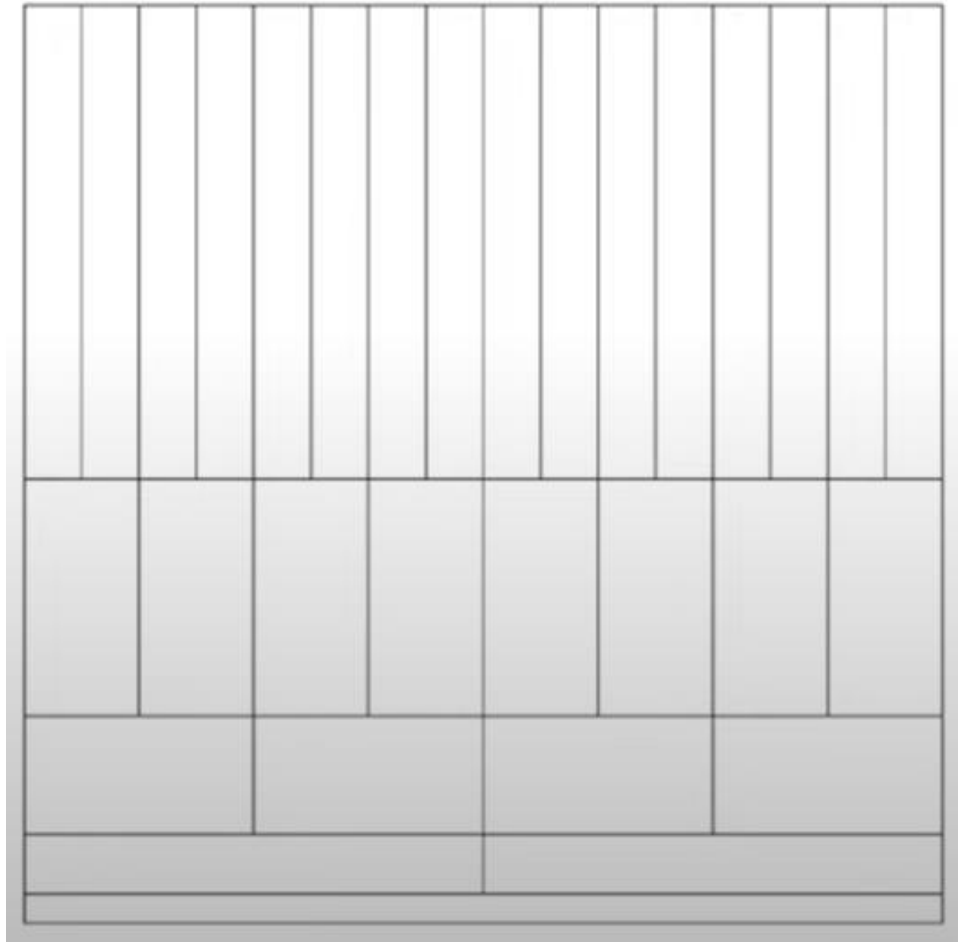
$$W(a,b) = K\int_{-\infty}^{+\infty}\psi^*(\frac{x-a}{b})f(x)dx$$

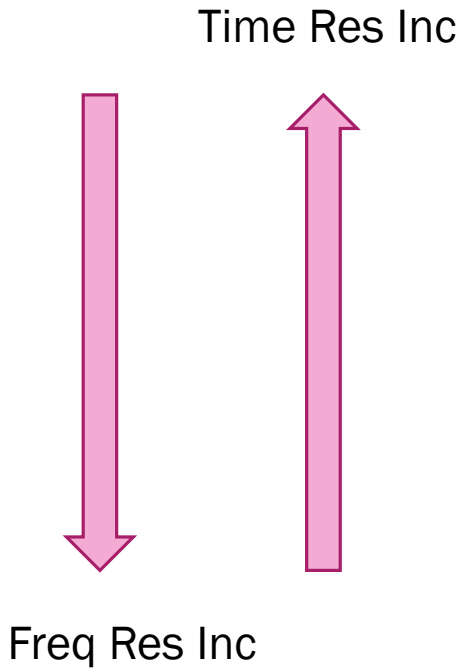
Wavelet decomposition

- MRA

  Analyses signal into different frequencies at different resolutions.

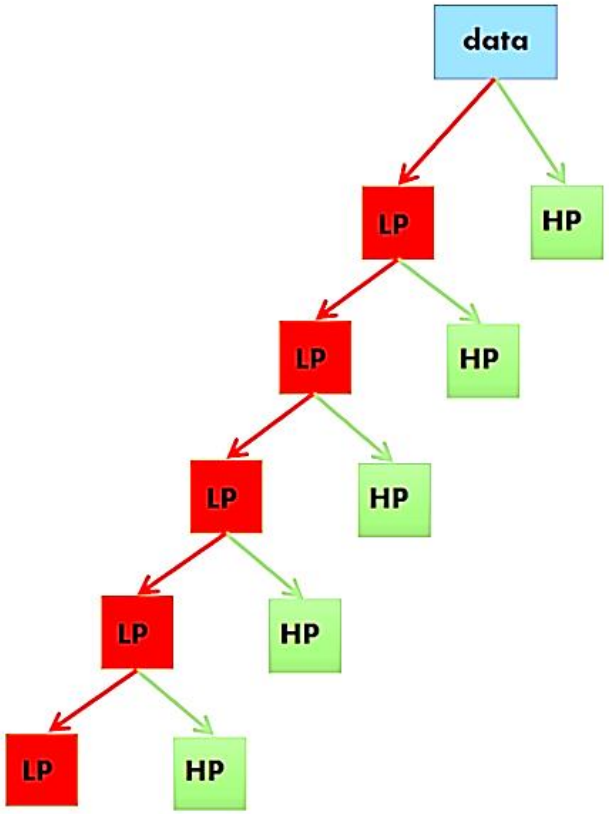


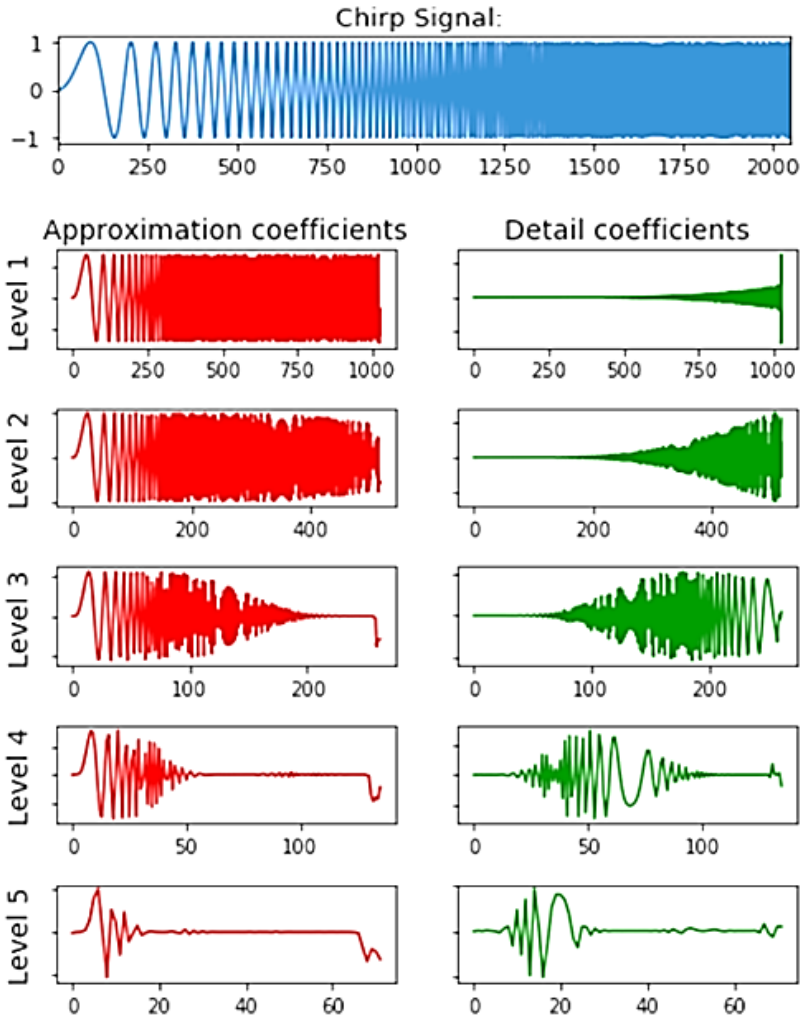




Wavelet decomposition

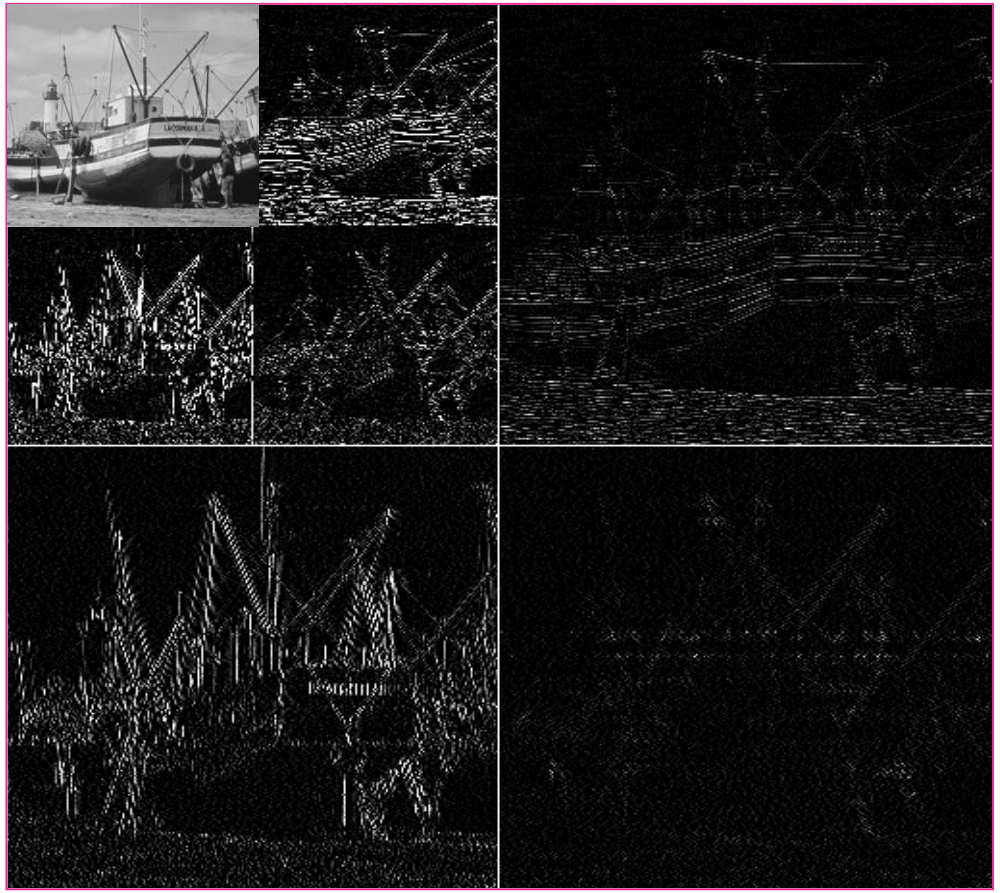
- Upchirp



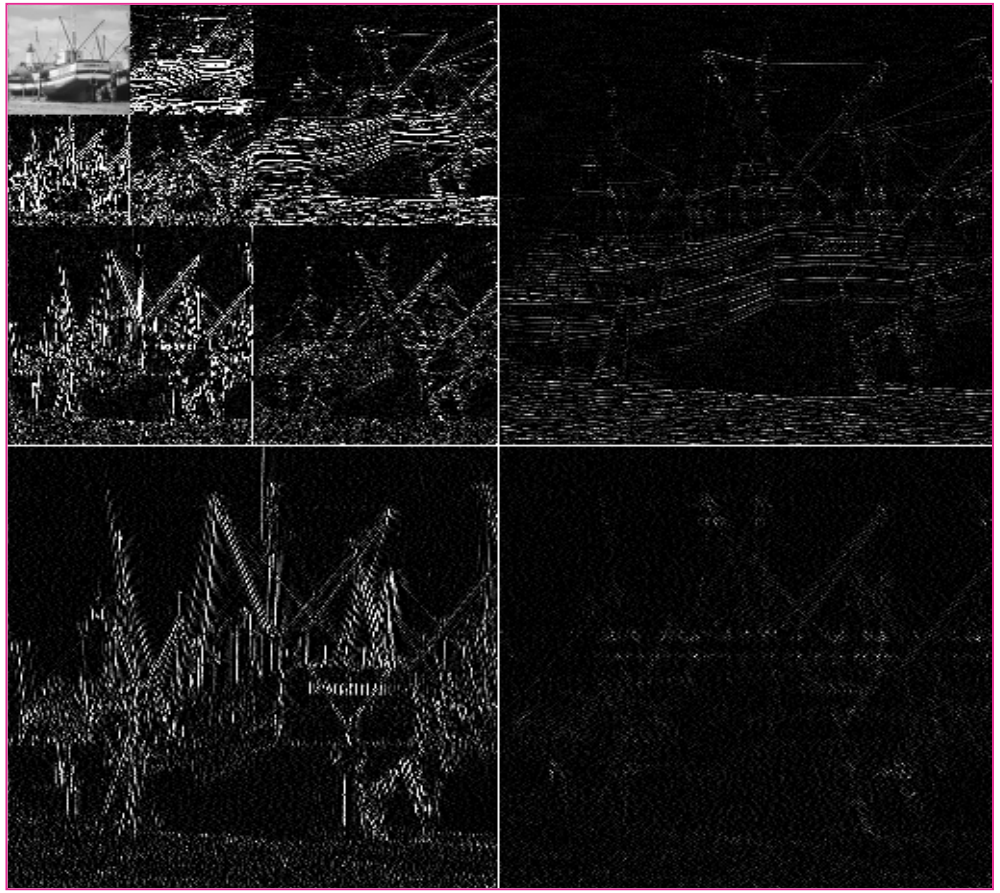


Wavelet decomposition

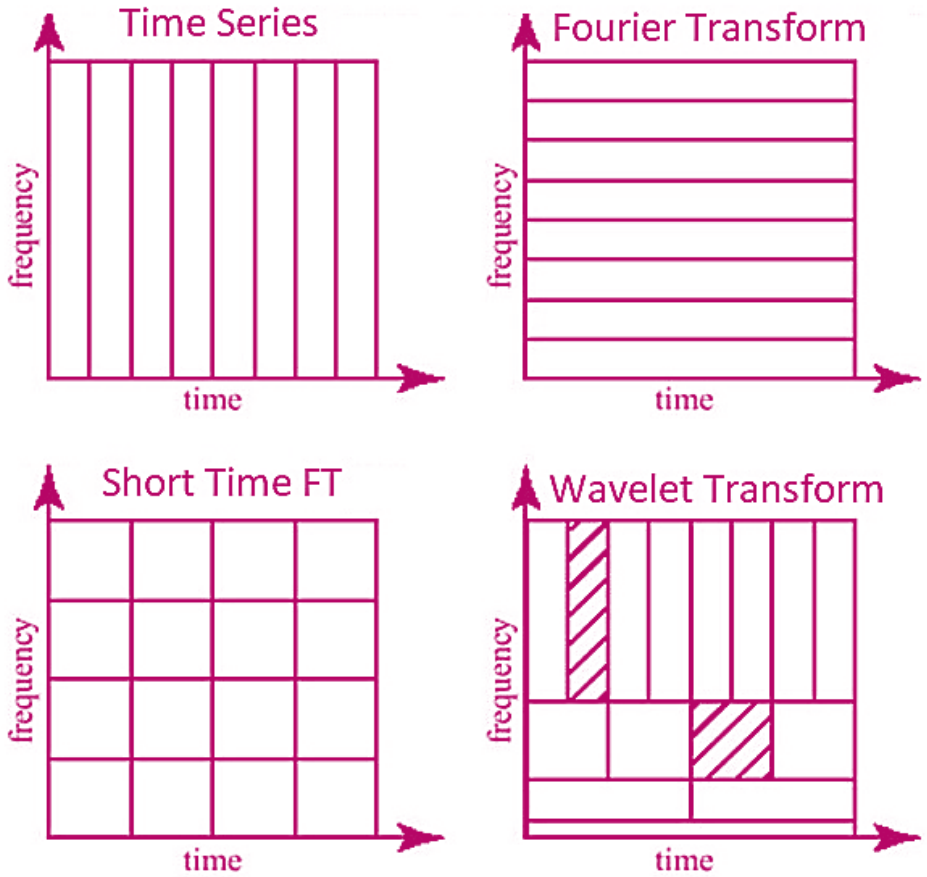
Wavelet decomposition



Wavelet decomposition



Time & frequency resolutions



Wavelet denoise

- Wavelet decompositions
  - useful in compression as well as denoise
  - importance of edges
  - maintaining edges while denoising is of critical importance

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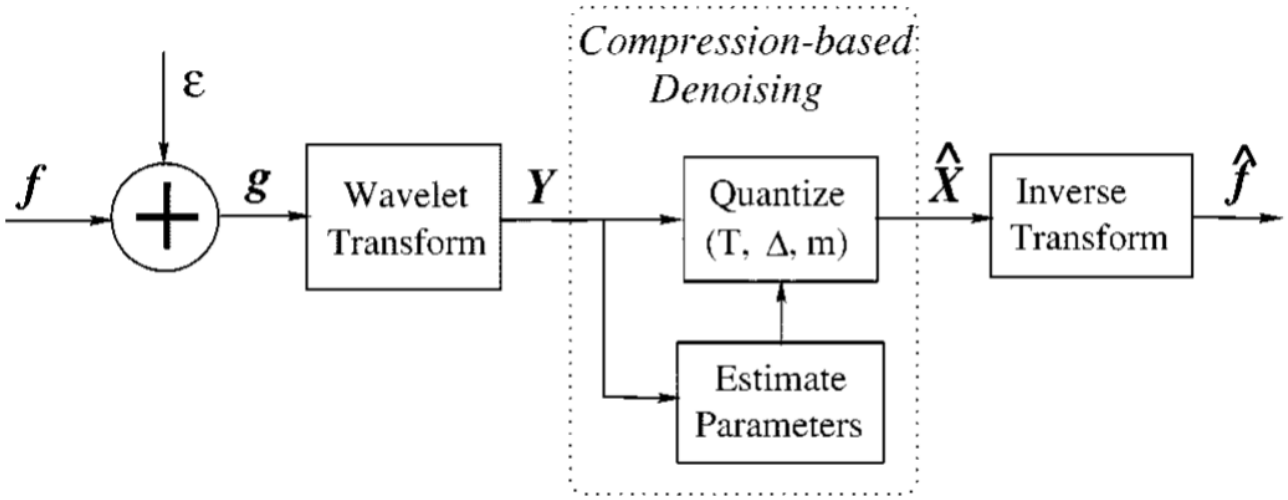
input

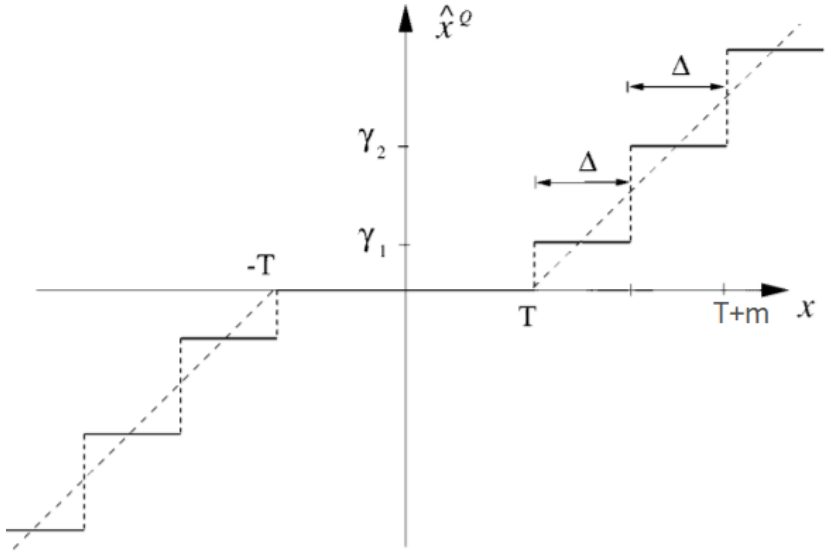
salt & pepper noise

low pass denoised

Wavelet denoise

- Compression based denoising





Chang et al. IEEE TIP'2000

Wavelet image denoising

- find DWT of an image
- threshold on DWT coefficients
  - sub-band adaptive TH
  - universal (soft/hard) TH
- find IDWT

Input

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Input

Wavelet denoised

Wavelet image denoising

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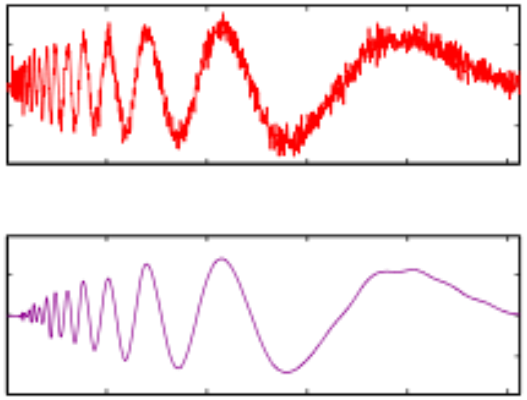
Conclusion

- Wavelet denoising



Conclusion

- Wavelet denoising

- MRA
  - Denoising
  - Wavelet transform
  - Thresholding in wavelet domain
  - Inverse wavelet transform