



# Wavelet Based Methods in Image Processing

Applied Mathematics Seminar

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# Background - 1

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- image compression course taught Winter 1997
- image processing course co-taught with Ed Doering Fall 1997
- attempt to make graduate level wavelet material accessible to undergraduates, mixed in Fourier methods

# Background - 2

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- matrix algebra and Fourier series base, DSP helpful
- MATLAB heavily used, MAPLE to a lesser extent
- course notes under revision
- Ed & Allen's web page:
- <http://fc.rose-hulman.edu/ud/ma490a/>

# Outline of Talks

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- *Lecture 1*- Introduction to Image Processing, restoration, denoising, edge detection and compression
- *Lecture 2*- Filtering and Fourier Methods
- *Lecture 3*- Localization, wavelet and windowed transforms
- *Lecture 4*- Filter bank implementation of wavelet methods

# Lecture 1

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- Image processing problems
- demos
- signal and image representation
- colour
- vector space models
- transforms and processing

# Image Processing Problems

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- *restoration*: unblurring photos, e.g., Hubble telescope images
- *edge detection*: medical imaging
- *denoising*: part of restoration
- *compression*: FBI finger print problem, image storage, transmission and retrieval

# Matlab Examples

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- restoration - ansmid3.m
- edge detection - edgedet.m
- denoising - wavelet toolbox
- compression - wavelet toolbox

# Image and Signal Models - 1

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- consider processing only, no capture or display
- concentrate on finite duration, discretely sampled signals and images
- continuous models used for analysis and modeling physical processes

# Image and Signal Models - 2

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- signals are vectors
- images are matrices
- signals and images are quantized (non-linear process)

# Colour

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- 8-bit pseudo-colour
  - 256 color levels
  - colour lookup table
  - show MATLAB example - eightbit.m
- 24 bit true colour
  - three colour matrices  $R$ ,  $G$ ,  $B$
  - 256 levels for each colour

# Vector & Matrix Space

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- good model for (additive) noise
  - $Y=X+E$
- superposition of basic signals and images - Fourier and wavelet analysis
- image processing as a linear operator
  - $X \rightarrow AX$  (signals)
  - $X \rightarrow AXB$  (images)

# General Transform Process

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- T is some transform
- the middle process is usually non-linear

