

Lecture Outline

Non-Linear Transformations

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- Linear vs Non-linear transformations
- Non-linear transformations
- Image transformations
- Fourier and Wavelet transforms

Linear vs Non-linear Transformations

- Linear transformations use a linear function
- Non-linear functions use a non-linear function
- Linear transformations maintain the distribution of the data
 - Can stretch the distribution
 - Multiplicative transformation
 - Can shift the distribution
 - Additive transformation

Linear vs Non-linear Transformations

- Non-linear transformations alter the distribution
- Can make the distribution normal
 - Why do this?
 - Remove outliers
- Can make the distribution uniform
 - Why do this?
 - Image processing

Non-linear Transformations

- Only applicable to ratio scale or above
 - Require true zero points
 - Log of negatives?
- Examples of transforms
 - Log
 - Exponential
 - Inverse of log
 - Binomial
 - Tanh

Image Transformations

- Many image processing transformations are non-linear
 - Why?
- Examples
 - Convolution
 - Sobel filters
 - Median filters

Image Transformations

- Convolution
 - General technique
 - Uses a small matrix
 - Kernel
 - Kernel is slid over the image
 - Moves one pixel at a time
 - Values in the kernel are used to transform values in image
 - Basis of many image processing techniques

Image Transformations

- Sobel filter
 - Based on a convolution
 - Edge detector
 - Edges have high contrast
 - Measures the gradient between adjacent groups of pixels
 - Uses specific kernel values

Image Transformations

- Median filters
 - Family of filters
 - Noise reduction
 - Impulse noise
 - Examine groups of pixels
 - Remove spikes in intensity
 - Different methods used
 - Not all non-linear

Fourier and Wavelet Transforms

- Two other important families of non-linear transform
 - Fourier
 - Wavelet
- Fourier is based on decomposing signals
 - All signals are composed of simple sinusoids
- Wavelet is based on restricted waveforms
 - Give better results than Fourier transforms

Summary

- Non-linear transforms alter the distribution of data
- Often used to transform images
- Many image transformations are based on convolution
- Fourier and wavelet transforms are other non-linear transformations