Principles of Digital Image Processing

Course Overview:
Attending this course will give you principles in using and designing Digital Image Processing algorithms used in the academy and industry today. Some ®MATLAB tools will be demonstrated as part of the training.

Who should attend?
This course is intended for engineers having some mathematical background in Signal Processing that want to broaden their knowledge in Image Processing theory.

Duration: 4 Days
Tools used: ®MATLAB
Topics Include:
- Image Processing theory
- Visualizing and Analyzing processing results
- Improving algorithm performance

Prerequisites:
Familiarity with Basic Signal Processing Theory. Some experience with ®MATLAB programming.

Course Outline
1. Introduction
   In this chapter we give an introduction to Digital Image Processing followed by some examples
   - What is Digital Image Processing?
   - The Origin of Digital Image Processing
   - Examples of fields that use Digital Image Processing
   - Fundamental steps in Digital Image Processing
   - Components of an Image Processing System

2. Digital Image Fundamentals
   In this chapter we learn about the fundamentals of Digital Images and the connection to the Visual Perception
   - Elements of visual perception
   - Light and Electro-Magnetic spectrum
   - Image sampling and quantization
   - Same basic relationship between pixels

3. Image Enhancement in the Spatial Domain
   In this chapter we learn about the Image Enhancement using some Spatial Domain Techniques
   - Background
   - Some basic gray level Transformations
   - Histogram Processing
   - Enhancement Arithmetic/Logic operations
   - Basics of Spatial filtering
   - Smoothing Spatial filtering
   - Sharpening Spatial filtering

4. Image Enhancement in the Frequency Domain
   In this chapter we learn about the Image Enhancement using some Frequency Domain Techniques
   - Background
   - Introduction to the Fourier Transform and the Frequency Domain
   - Smoothing Frequency Domain filters
   - Sharpening Frequency Domain filters
   - Homomorphic filtering
   - Implementation

5. Image Restoration
   In this chapter we look at the problem of image degradation and the process of restoration to solve this problem
   - A model of the Image Degradation/Restoration process
   - Noise models
   - Periodic noise reduction by frequency domain filtering
   - Linear Position – Invariant degradation
   - Estimation the degradation function
   - Inverse filtering
   - Constrained Least Squares filtering
   - Geometric mean filtering
   - Geometric transformations

6. Multiresolution Processing
   In this chapter we look at the mathematics of multiresolution analysis with the use of wavelet Transform
   - Background
   - Multiresolution Expansion
   - Wavelet Transform
   - Fast Wavelet Transform
   - Wavelet Packet

7. Image Compression
   In this chapter we learn about Image compression techniques
   - Fundamentals
   - Image compression models
   - Elements of Information Theory
   - Error-Free compression
   - Lossy compression

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8. Image Segmentation
In this chapter we look at techniques for Image Segmentation
- Detection of discontinuities
- Edge Linking and Boundary Detection
- Thresholding
- Region-based segmentation
- Segmentation by Morphological Watersheds
- The use of Motion in segmentation

9. Object Recognition
In this chapter we look the mathematics of multiresolution analysis with the use of wavelet Transform
- Patterns and Pattern classes
- Recognition based on Decision-Theoretic methods
- Neural Networks
- Structural methods

10. Advanced Topics
- Radon Transform
- Hough Transform
- Machine Vision
- Machine Learning

11. Summary