Course Title:

Image Processing with MATLAB

Course Purpose

This two-day course provides hands-on experience with performing image analysis. Examples and exercises demonstrate the use of appropriate MATLAB® and Image Processing Toolbox™ functionality throughout the analysis process.
Topics include:

- ✓ Importing and exporting images
- ✓ Enhancing images
- ✓ Detecting edges and shapes
- ✓ Segmenting objects based on their color and texture
- ✓ Modifying objects' shape using morphological operations
- ✓ Measuring shape properties
- ✓ Performing batch analysis over sets of images
- ✓ Aligning images with image registration
- ✓ Detecting, extracting, and matching image features

Pre- requisites

MATLAB Fundamentals

Course Duration

- ✓ 2 training days
- ✓ Hours: 09:00-17:00
- ✓ Total training hours: 16

Teaching method

The course combines lectures, demonstrations and practical exercises in MATLAB, using original training books from MathWorks. The course is in Hebrew, but the training materials are in English.

Course Objective:

Introduction

Objective: Understand MathWorks products, a brief company history (The MathWorks & Systematics Limited), and course schedule.

Importing and Visualizing Images

Objective: Import and visualize different image types in MATLAB. Manipulate images for streamlining subsequent analysis steps.

- Importing, inspecting, and displaying images
- Converting between image types
- Visualizing results of processing
- Exporting images

Preprocessing Images

Objective: Enhance images for analysis by using common preprocessing techniques such as contrast adjustment and noise filtering.

- Adjusting contrast
- Reducing noise with spatial filtering
- Equalizing inhomogeneous background
- Processing images in distinct blocks
- Measuring image quality

Color and Texture Segmentation

Objective: Segment objects from an image based on color and texture. Use statistical measures to characterize texture features and measure texture similarity between images.

- Transforming between image color spaces
- Segmenting objects based on color attributes and color difference
- Segmenting objects based on texture using nonlinear filters
- Analyzing image texture using statistical measures like contrast and correlation

Improving Segmentation

Objective: Improve binary segmentation results by refining the segmentation mask. Use interactive and iterative techniques to segment image regions.

- Using morphological operations to refine segmentation masks
- Segmenting images and refining results interactively
- Using iterative techniques to evolve segmentation from a seed

Finding and Analyzing Objects

Objective: Count and label objects detected in a segmentation. Measure object properties like area, perimeter, and centroids.

- Extracting and labeling objects in a segmentation mask
- Measuring shape properties
- Separating adjacent and overlapping objects with watershed transform

Detecting Edges and Shapes

Objective: Detect edges of objects and extract boundary pixel locations. Detect objects by shapes such as lines and circles.

- Detecting object edges
- Identifying objects by detecting lines and circles
- Performing batch analysis over sets of images

Spatial Transformation and Image Registration

Objective: Compare images with different scales and orientations by geometrically aligning them.

- Applying geometric transformations to images
- Aligning images using phase correlation
- Aligning images using point mapping

Automating Image Registration with Image Features

Objective: Detect, extract, and match sets of image features to automate image registration.

- Detecting and extracting features
- Matching features to estimate geometric transformation between two images

Conclusion

Training Center Systematics - Contact information:

Phone number: 03-7660111 Ext: 6 **Email:** training@systematics.co.il

Website: http://www.systematics.co.il/courses/mathworks/details/

Course Title:

Computer Vision with MATLAB

Course Purpose:

This one-day course provides hands-on experience with performing computer vision tasks. Examples and exercises demonstrate the use of appropriate MATLAB® and Computer Vision Toolbox™ functionality.

Topics include:

- ✓ Importing, displaying, and annotating videos
- ✓ Detecting objects in videos
- ✓ Estimating motion of objects
- ✓ Tracking a single object or multiple objects
- ✓ Removing lens distortion and measuring planar objects

Pre- requisites:

MATLAB Fundamentals or equivalent experience using MATLAB.

Image Processing with MATLAB and basic knowledge of image processing and computer vision concepts.

Course Duration

- ✓ 1 training day
- ✓ Hours: 09:00-17:00
- ✓ Total training hours: 8

Teaching method

The course combines lectures, demonstrations and practical exercises in MATLAB, using original training books from MathWorks. The course is in Hebrew but the training materials are in English.

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Course Outline:

Importing, Visualizing, and Annotating Videos

Objective: Import videos into MATLAB, as well as annotate and visualize them.

The focus is on using System Objects™ for performing iterative computations on video frames.

- Importing and displaying video files
- Highlighting objects by drawing markers and shapes like rectangles
- Combining and overlaying two images
- Performing iterative computations on video frames

Detecting Objects
Objective: Utilize machine learning and deep learning algorithms for complex object detection.

- Marking objects of interest in training images
- Training and using a cascade object detector
- Using a deep learning object detector

Motion Estimation

Objective: Estimate direction and strength of motion in a video sequence.
- Understanding motion perception in images
- Estimating motion using block matcher
- Estimating motion using optical flow methods

Tracking Objects

Objective: Track single and multiple objects and estimate their trajectory. Handle occlusion by predicting object position.
- Predicting object position using the Kalman filter
- Tracking multiple objects using a GNN tracker

Camera Calibration
Objective: Remove lens distortion from images. Measure size of planar objects.

- Estimating intrinsic, extrinsic, and lens distortion parameters of a camera
- Visualizing the calibration error
- Removing lens distortion
- Measuring planar objects in real-world units

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