

CS 556: Computer Vision

Matlab and C (OpenCV)

Toolboxes, Libraries, and Online Code

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Matlab

Matlab: Image Processing Toolbox

- Images
 - [imread](#) : Read image
 - [imwrite](#) : Write Image
 - [imshow](#) : Display image
 - [im2bw](#) : Convert image to binary image
 - [im2double](#) : Convert image to double precision
 - [im2uint8](#) : Convert image to 8-bit unsigned integers
 - [rgb2gray](#) : Convert RGB image or colormap to grayscale
 - [imrotate](#) : Rotate image
 - [imresize](#) : Resize image
 - [imtransform](#) : Apply 2-D spatial transformation to image
 - [bwboundaries](#) Trace region boundaries in binary image
 - [bwtraceboundary](#) Trace object in binary image
 - [bwlabel](#) Label connected components in 2-D binary image

Matlab: Image Processing Toolbox

- [corner](#) Find corner points in image
- [edge](#) Find edges in grayscale image
- [edgetaper](#) Taper discontinuities along image edges
- [hough](#) Hough transform
- [houghlines](#) Extract line segments based on Hough transform
- [houghpeaks](#) Identify peaks in Hough transform
- [imcontour](#) Create contour plot of image data
- [imhist](#) Display histogram of image data
- [regionprops](#) Measure properties of image regions
- [corr2](#) 2-D correlation coefficient
- [mean2](#) Average or mean of matrix elements
- [std2](#) Standard deviation of matrix elements
- [mmreader](#) For reading Videos

Matlab: Image Processing Toolbox

- Image Example (Convert image into grayscale and find its edges):

```
I= imread('example.jpg');  
I= im2double(I); %or I=double(I);  
G=rgb2gray(I);  
G=uint8(G);  
figure;  
imshow(G);  
imwrite(G, 'out.png');  
E=edge(G,'canny',0.3);  
figure;  
imshow(E);  
imwrite(E, 'outEdge.pgm');  
.....
```

Matlab: Image Processing Toolbox

- Video Example (Convert an movie into grayscale):

```
readerobj = mmreader('example.mpg', 'tag', 'myreader1');
```

```
numFrames = get(readerobj, 'numberOfFrames');
```

```
I=read(readerobj,1);
```

```
for k = 1 : numFrames
```

```
    I=read(readerobj,k);
```

```
    G=rgb2gray(I);
```

```
    mov(k).img =G;
```

```
end
```

```
aviobj = avifile('example.avi')
```

```
for k=1: numFrames
```

```
    aviobj = addframe(aviobj,mov(k).img);
```

```
end
```

```
aviobj = close(aviobj);
```

C (OpenCV)

OpenCV: Installation

- [Source Code is available online](#)
- [Tutorial and step by step installation](#)
- [Noah Kuntz Tutorials](#)

OpenCV: Tutorials

- OpenCV Tutorial 1 [Getting started and image manipulation, chapters 1, 2](#)
- OpenCV Tutorial 2 [Data Types, chapter 3](#)
- OpenCV Tutorial 3 [HighGUI Interface Toolkit, chapter 4](#)
- OpenCV Tutorial 4 [Image Processing, chapter 5](#)
- OpenCV Tutorial 5 [Image Transforms, chapter 6](#)
- OpenCV Tutorial 6 [Histograms and Matching, chapter 7](#)
- OpenCV Tutorial 7 [Contours, chapter 8](#)
- OpenCV Tutorial 8 [Image Parts and Segmentation, chapter 9](#)
- OpenCV Tutorial 9 [Tracking and Motion, chapter 10](#)
- OpenCV Tutorial 10 [Camera Models and Calibration, chapter 11](#)
- OpenCV Tutorial 11 [Machine Learning, chapter 13](#)

OpenCV: Face Detection and Tracking

- [OpenCV Part 1](#) Introduction, and how to input from different devices (Images, Videos, Cameras)
- [OpenCV Part 2](#) Face Detection
- [OpenCV Part 3](#) Face Tracking
- [OpenCV Part 4](#) Face Detection using Eigen Faces
- [OpenCV Part 5](#) Implementing Eigen Faces

OpenCV: Functions

- [OpenCV 1.0 API](#)
- [OpenCV 2.1 API](#)
- Functions For Images:
 - cvLoadImage
 - cvSaveImage
 - PyrMeanShiftFiltering
 - Watershed
 - FindContours
 - Threshold
 - CvtColor
 - 2DRotationMatrix
 - Dilate
 - Erode
 - CornerHarris
 - Canny
 - HoughLines2
 - HoughCircles
 - MatchTemplate

OpenCV: Functions

- MatchShapes
- CalcImageHomography
- FindHomography
- CalibrateCamera2
- FindExtrinsicCameraParams2
- Undistort2
- WarpPerspective
- GetPerspectiveTransform
- WarpAffine
- GetAffineTransform.
- FindChessboardCorners
- DrawChessBoardCorners
- FindFundamentalMat
- ComputeCorrespondEpilines
- ConvertPointsHomogenous
- DrawChessBoardCorners

OpenCV: Functions

- Functions For Videos:
 - CvCapture
 - cvCreateVideoWriter
 - cvWriteFrame
- Functions For Camera
 - cvCreateCameraCapture
 - cvQueryFrame
- Functions For Display
 - cvWaitKey
 - cvSetMouseCallback
 - cvSetTrackbarPos
 - cvGetTrackbarPos
 - cvNamedWindow
 - cvShowImage

Online Code

Keypoints

- [Affine Covariant Features](#) (Matlab and Linux binaries)
 - *Harris-Affine & Hessian Affine*
 - *MSER*
 - *Salient regions*
- [Ivan Laptev](#) (Matlab)
 - *Harris-Affine & Hessian Affine*
- [David Lowe](#) (Matlab)
 - *Sift*
- [Luc Van Gool](#) (Matlab and C)
 - [SURF](#)
- [Engin Tola](#) (Matlab and C)
 - *Daisy*

Camera Calibration

- [Jean-Yves Bouguet](#) (Matlab)
- [Christian Wengert](#) (Matlab)
 - Add on to the main toolbox

Epipolar Geometry

- [Multiple View Geometry](#) (Matlab)
 - Fundamental Matrix
 - Image correspondences
 - Homography
- [Peter Kovesi's Matlab Functions](#) (Matlab)
 - Homography
 - Ransac
 - Line Fitting
- [The Fundamental Matrix Song](#)

Tracking

- [Fabian Wauthier](#) (Matlab)
 - Motion Tracking
- [Hungarian Algorithm](#) (Matlab)

Matching

- [DTW](#) (Matlab)
- [William Brendel](#)
 - CDTW (C)

Segmentation

- [NCUT](#) (Matlab)
- [Berkeley](#) (Matlab under Linux 64-bits)
- [MeanShift](#) (C code and Windows Binaries)
 - [More details for adding Binary to Matlab](#)
 - [More details for MeanShift](#)
 - [More Code for MeanShift](#)
- [Watershed](#) (Matlab)

Object Detection

- [Pedro F. Felzenszwalb](#) (Matlab under Linux)
- [Navneet Dalal](#) (OpenCV and Linux Binaries)
- [Bastian Leibe](#) (OpenCV and Linux Binaries)

Other

- [Computer Vision Software](#)
- [CVPR TOOLBOX](#)
 - cvEucdist - Euclidean distance
 - cvMahaldist - Mahalanobis distance
 - cvGmm - Construct a GMM structure
 - cvGmmEm - Train Gaussian Mixture Models (GMM) using EM algorithm.
 - cvGmmPdf - Probability Density Function of Mixtures of Gaussian
 - cvHarrisCorner - Harris Corner Detector
 - cvHisteq - Histogram Equalization
 - cvHistnorm - Histogram Normalization or Streching
 - cvKmeans - K-means clustering
 - cvKnn - K-Nearest Neighbor classification
 - cvLda - Fisher's Linear Discriminant Analysis (FLDA or LDA)
 - cvLdaInvProj - Inverse LDA Projection
 - cvLdaProj - Projects feature vectors into LDA space
 - cvLibsvmPredict - Multi-class extension of LIBSVM [1]
 - cvLibsvmTrain - Multi-class extension of LIBSVM [1]
 - cvMatchTemplate - Template Matching
 - cvMeanCov - Compute mean and covariance (variance for 1-D)

Other

- cvPca - Principal Component Analysis
- cvPcaDiffs - Distance "in" and "from" feature space [1]
- cvPcaDist - Distance between a point to a PCA space
- cvPcaInvProj - Inverse PCA Projection
- cvPfa - Principal Feature Analysis (Feature Selection)
- cvrKnn - Run Interface of cvKnn
- cvSvmSimple - SVM Classifier for linearly separable data
- cvuNormalize - (CV Utility) Normalize Array in [low, high]
- cvuOpenCvLoad - (CV Utility) Load data in OpenCV CvFileStorage XML format
- cvuOpenCvSave - (CV Utility) Save data in OpenCV CvFileStorage XML format
- cvuPowerlawFit - (CV Utility) Curve fitting by power law form $y = p(1) * x^{p(2)}$