# Visual Perception

# Matlab User Guide

## Master in Computer Vision


## UNIVERSITE DE BOURGOGNE

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# Introduction:

Developing Computer Vision applications are difficult. One should consider the capabilities of the framework, on the other hand how this framework will react and perform on given test data. In other case, one may want to see only effect of the consecutive image processing functions on test data. In both and many cases, small toolboxes of the frameworks help people to see results easily, fast and enable them to fast prototyping. Hence this toolbox is created for Computer Vision application developers and enthusiast who want to see image processing functions on their images with very basic knowledge. It's developed with minimal design, which makes it easy to use. However it is also powerful toolbox due to its support of parameters.

# About The GUI:

1. Image Toolbox: Basics

This application is embedding functions of Matlab 2016b for users. This application consist of one GUI for displaying input and output images by Matlab. It accepts one image at a time and storing it as original image. Each modification is applied on output image consecutively. By default, all operations are disabled until you select an image. And if you press any button without uploading the image, it will automatically generate a pop up showing that please upload an image first.

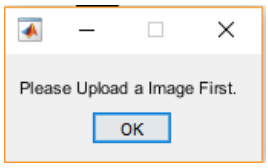


*Figure1: Pop up if pressed button w/o image upload*

2. User Interface

User interface consist of 47 buttons on a single view which embeds all image processing functions.

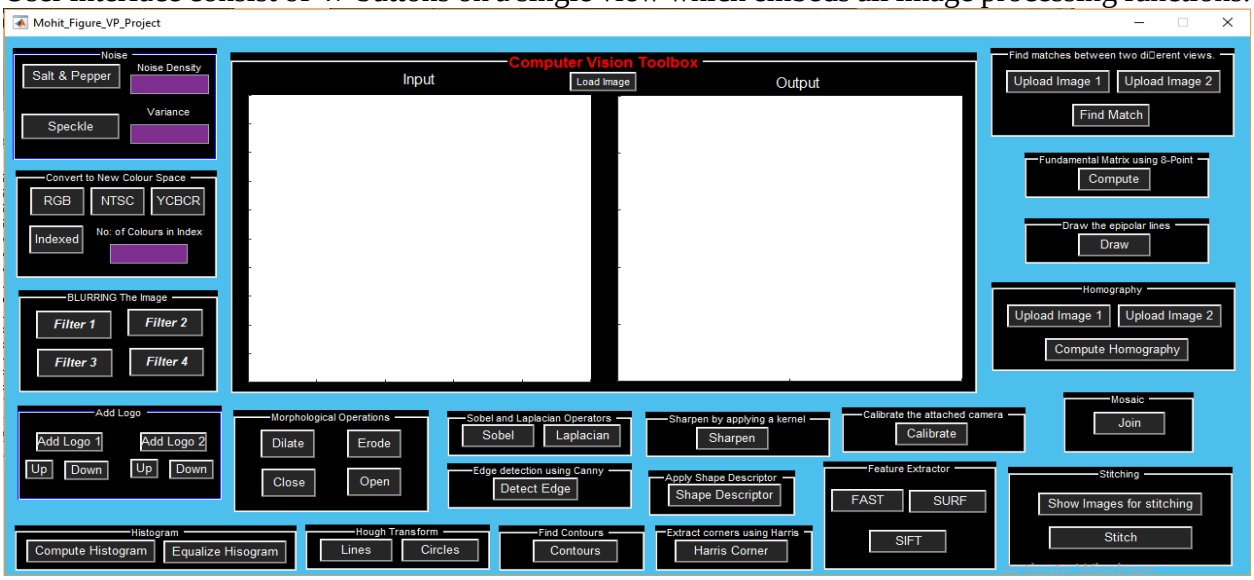


*Figure 2: Matlab Toolbox*

Main buttons:

- Load Image: Loads image.

Panels:

- Noise: Adding salt and pepper noise.
- Color: Changing color space.
- Blur: Blurring operations.
- Logo: Adding logo.
- Histogram: Calculating and Equalizing Histogram.
- Morph: Morphological Operations.
- Hough: Hough Transform finding lines and circles.
- Sobel: Sobel and Laplacian derivative operators.
- Edge: Canny Edge Detect.
- Contour: Detects contours.
- Sharpen: Sharpening images.
- Harris: Edge Detection using Harris edge detection method.
- Shape Descriptor: Detecting shapes in image.
- Feature Extractor: FAST, SURF and SIFT.
- Calibration: Calibrates the camera.
- Matches: Finds matches between 2 different views.
- Fundamental Matrix: Calculates fundamental matrix using 8-point algorithm.
- Epipolar lines: computes epipolar lines in two images.
- Homography: Compute Homography.
- Mosaic: Mosaic two images.
- Stitching: Stitches a given number of images.

## 3. Image Input and Output

Image input and output is very easy in this toolbox. "Load Image" button in center opens file under the Input section in axes and enable to select any image in your computer. Supported formats are *.png, *.jpg, *.jpeg, and *.bmp; by default, Matlab loads images in RGB color space. As soon as you select and load image, image is opened under the Input section in axes.

## 4. Noise

In "Noise" Panel, there is Salt and Pepper noise and speckle noise option. Salt and pepper noise is adding white and black pixels to your image with given amount as "Noise Density" parameter. The same is in the case of Spackle Noise, it will add noise to your image with given amount as "Variance" parameter.

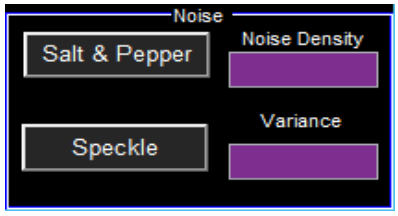


*Figure 3: Noise Panel*

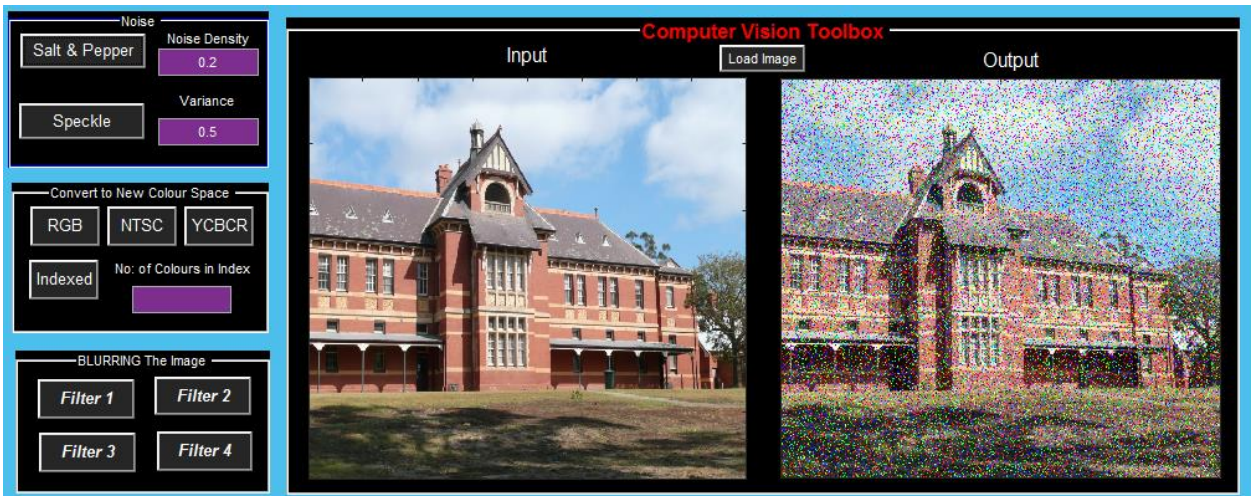


*Figure 4: Noise applied to image*

## 5. Logo

In "Logo" tab, first you need to add logo by clicking "Add Logo". You should select logo smaller or equal to output image size. Click "Add Logo -1" to add your first logo and click "Add Logo -2" to add your second logo. You can manipulate after adding logo to your image, by moving it to the top right or to the bottom right of the image by using buttons.


*Figure 5: Logo Panel*

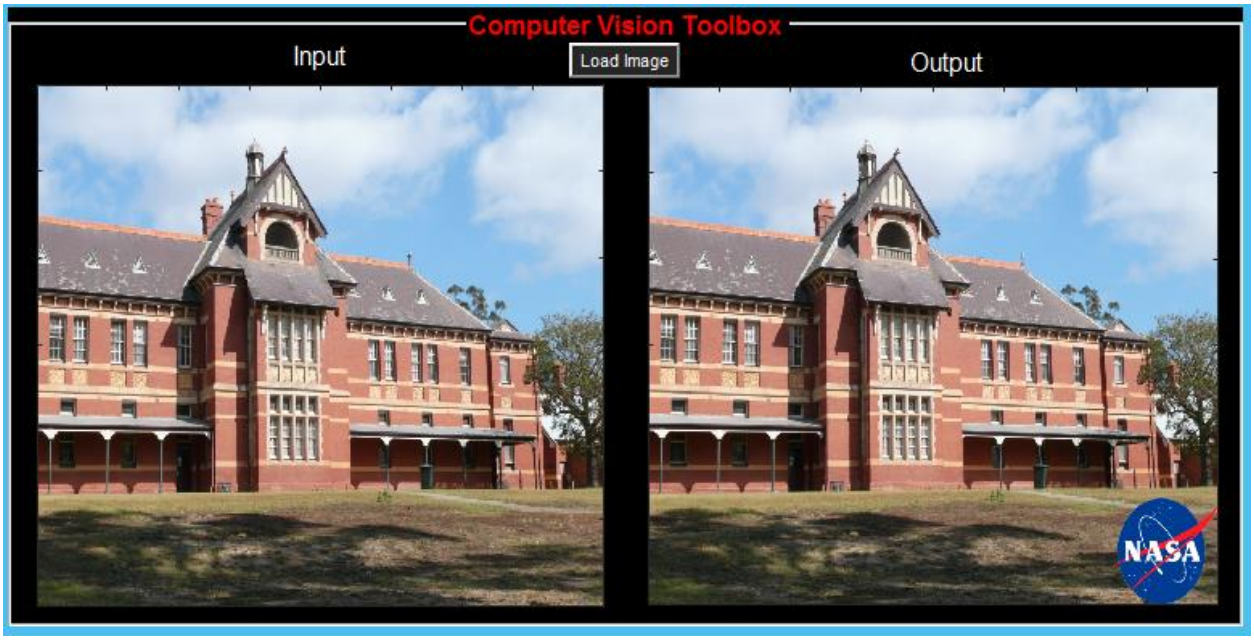


*Figure 6: Logo added to image*

## 6. Color space

In "ColorSpace" tab, you can change the color space of your current image. Supported color spaces are: RGB, YCBCR, NTSC, and Indexed. Color space panel is showing the different color space of the image. Each time you change the color space 'New Color Space' are updated accordingly.

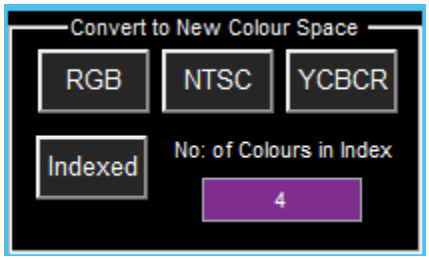


*Figure 7: ColorSpace Panel*

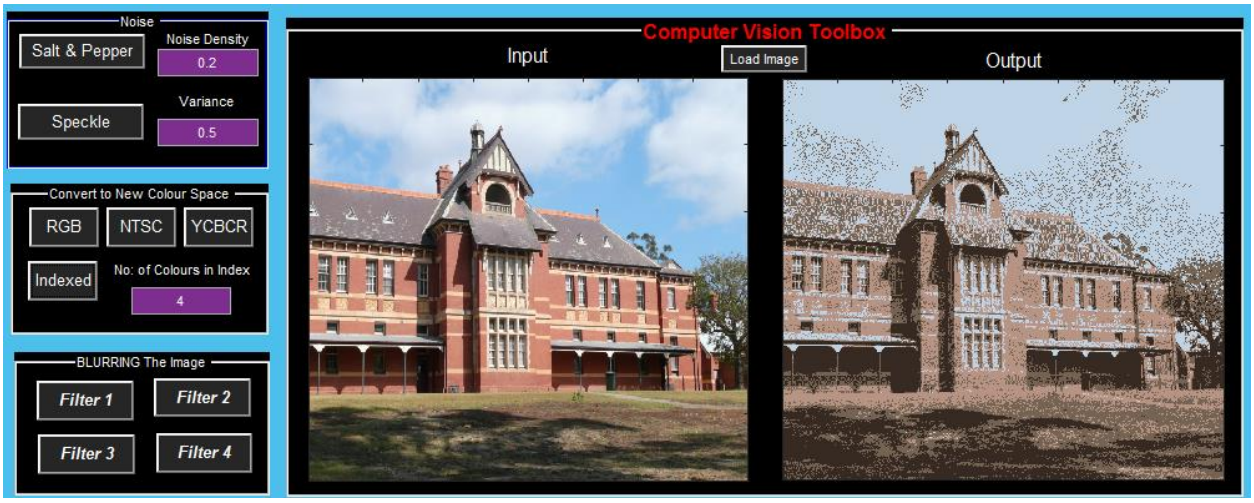


*Figure 8: ColorSpace Panel changing ColorSpace of image*

## 7. Histogram

In "Histogram" tab, you can calculate histogram of the image or equalize histogram of the current image.

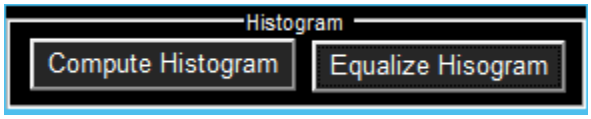


*Figure 9: Histogram Panel*

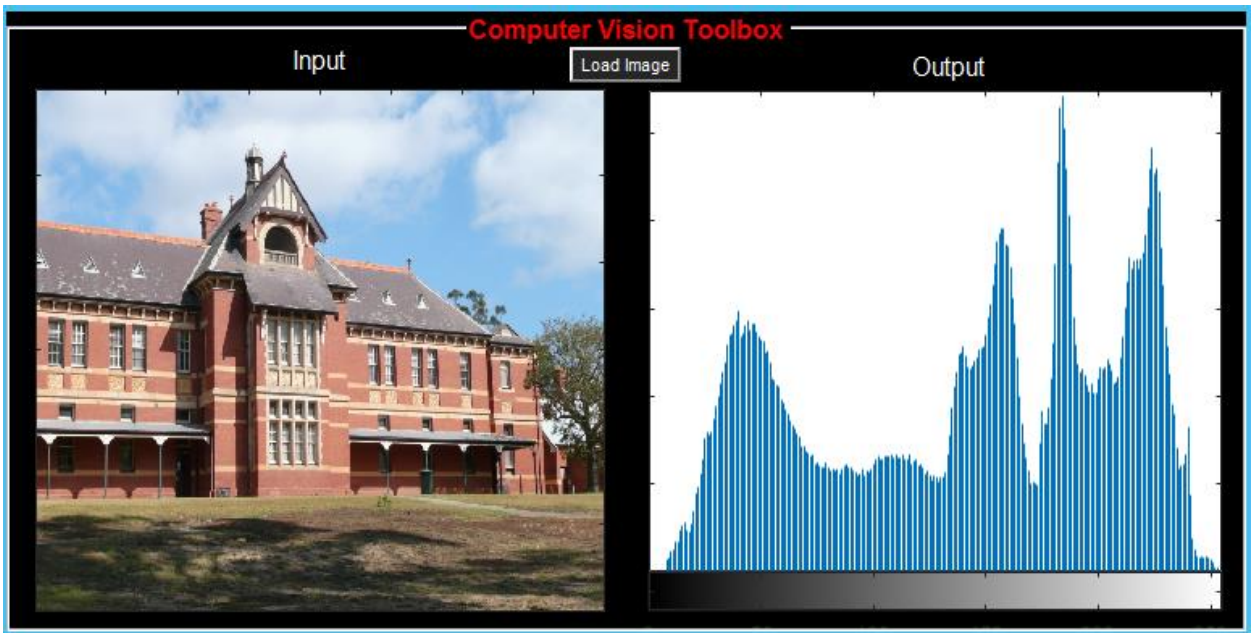


*Figure 10: Computing Histogram of image*

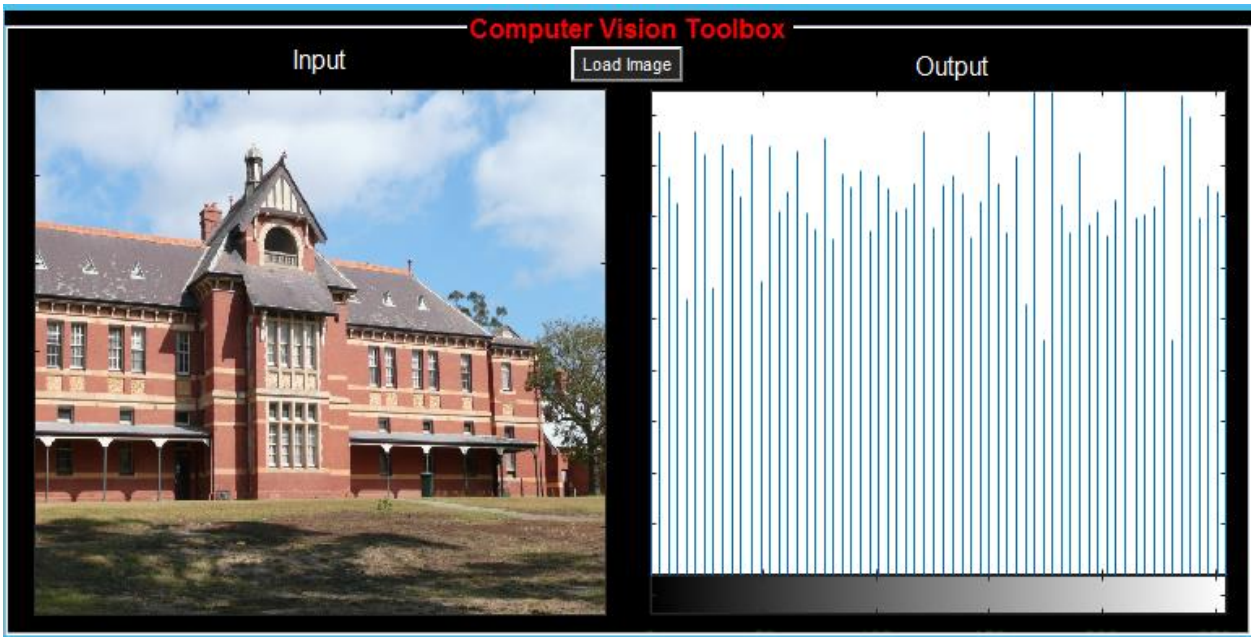


*Figure 11: Equalizing Histogram of image*

## 8. Morphological Operations

In "Morph" panel, you can perform morphological operations to your current image. Available operations are; Dilation, Erosion, Opening, Closing.


*Figure 12: Morphological Panel*


*Figure 13: Dilation of image*


*Figure 14: Eroding the image*

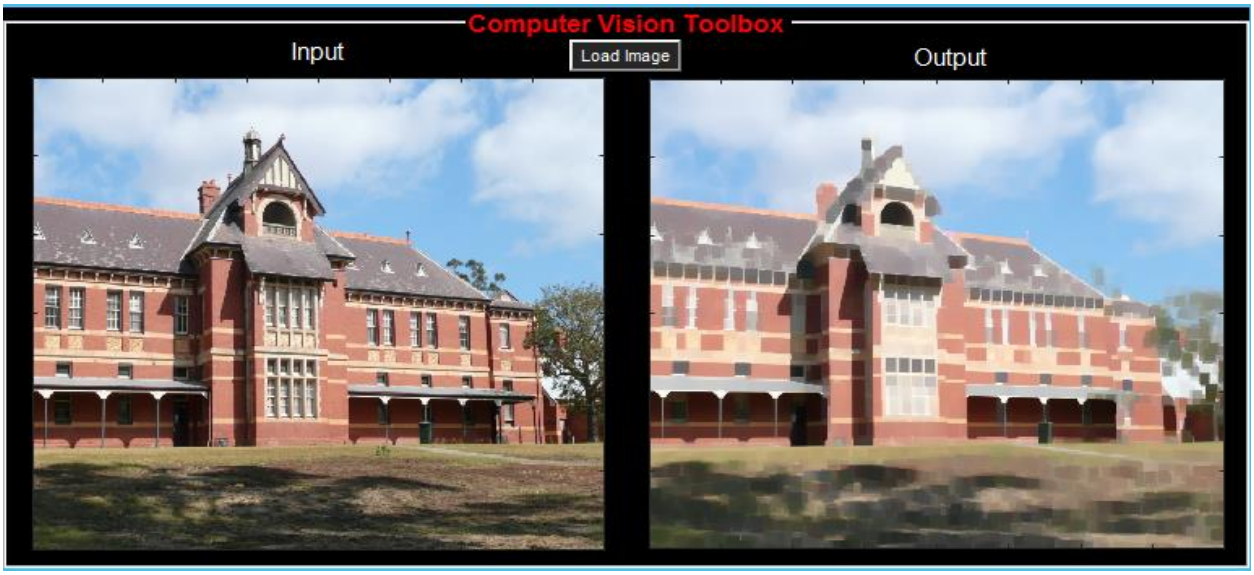


*Figure 15: Close operation on image*


*Figure 16: Open operation on image*

## 9. Blur

In "Blur" panel, you can perform blurring your image with Homogeneous, Gaussian, Median or bilateral smoothing. You also have options to specify kernel size, its anchor and border replication method. The first filter performs the homogeneous smoothing, second as Gaussian, third as median and last filter used bilateral smoothing.


*Figure 17: Morphological Panel*

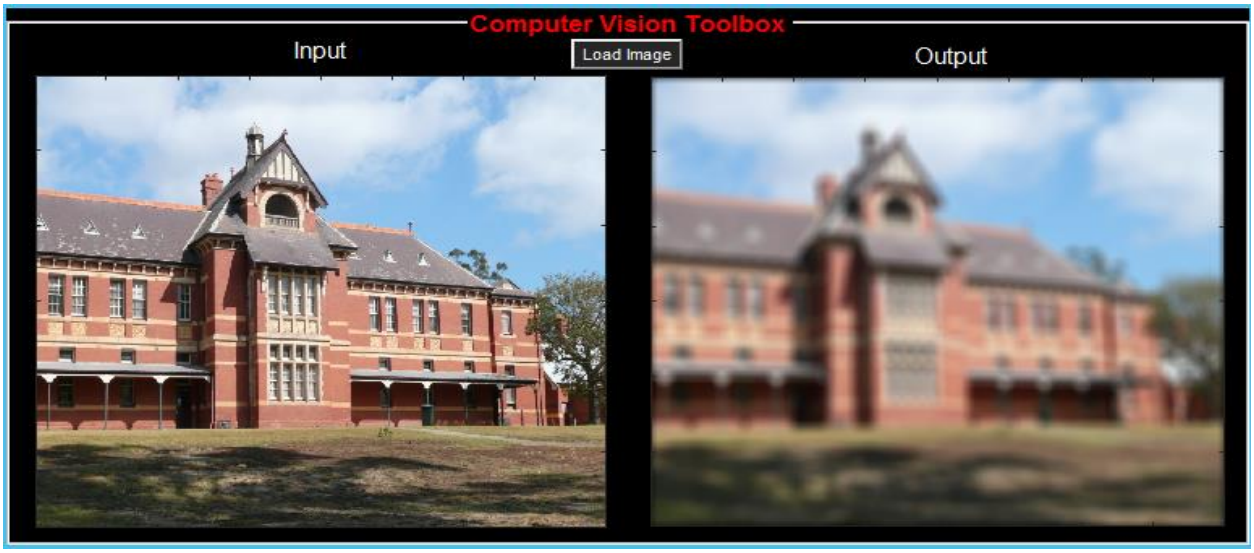


*Figure 18: Blurring operation on image*

## 10. Sobel And Laplacian

In "Sobel and Laplacian" panel, you can use Sobel and Laplacian operators. There are two buttons in the panel, pressing Sobel, The Sobel operation will be performed and by pressing the Laplacian, Laplacian operation will be performed. The output of both operations can be clearly seen in the output plane.


*Figure 19: Sobel and Laplacian Panel*

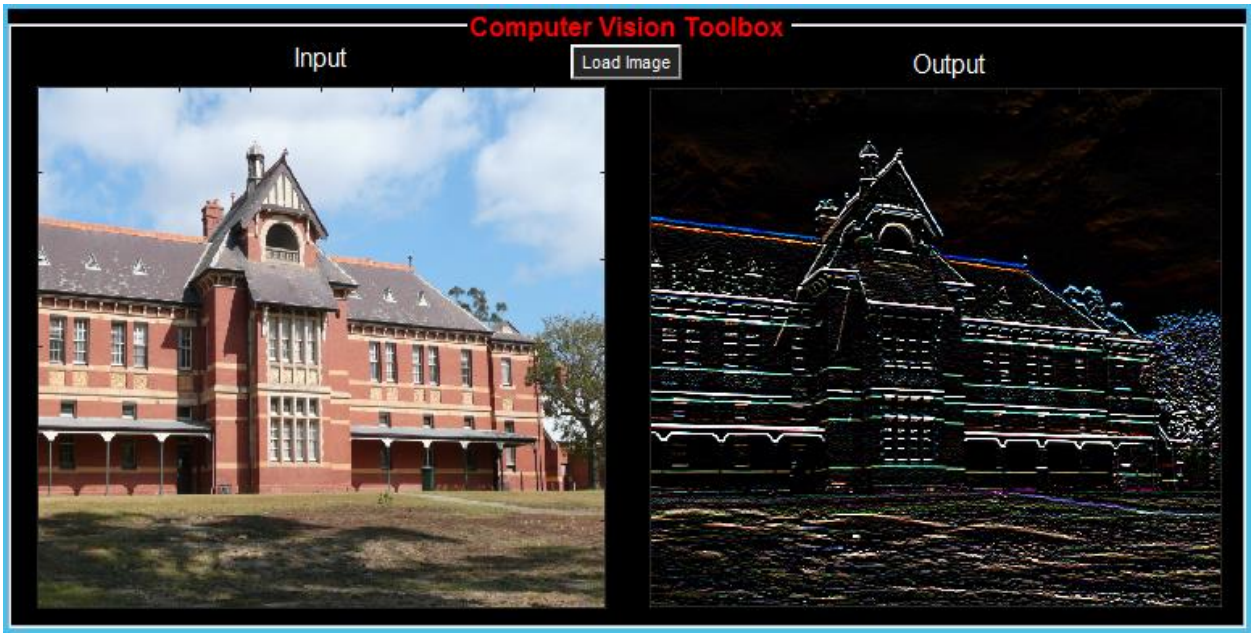


*Figure 20: Sobel operation on image*

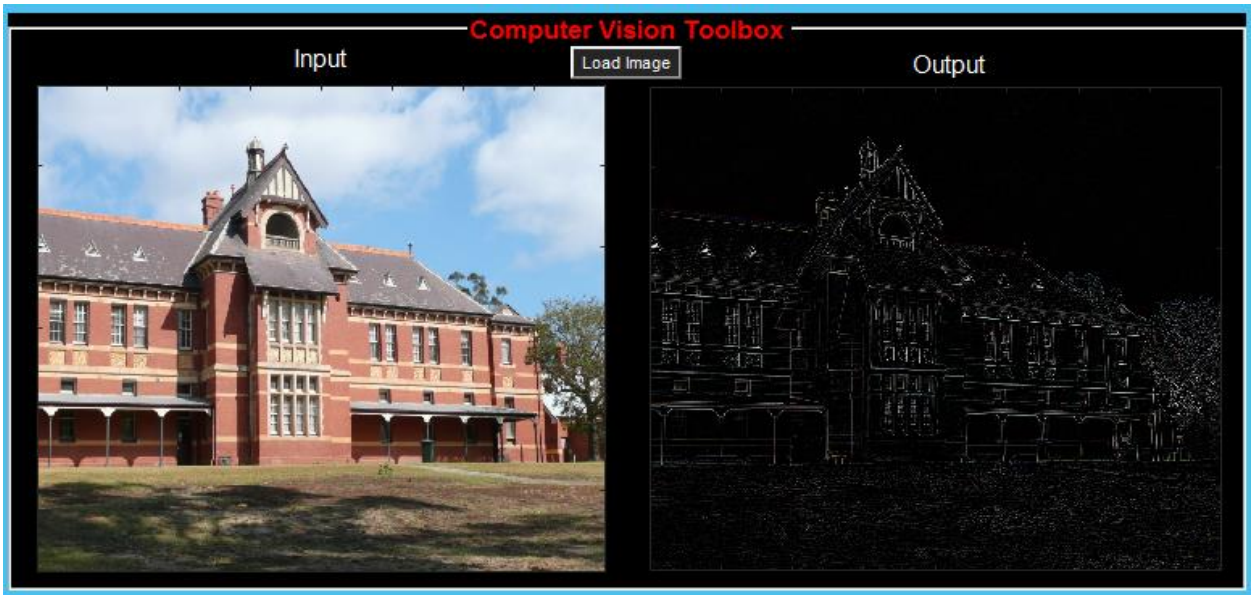


*Figure 21: Laplacian operation on image*

## 11. Sharpen

In "Sharpen" panel, you can perform sharpening on images. Behind the code, Gaussian blurred image is weighted with the current image.

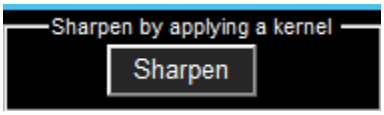


*Figure 22: Sharpen Panel*

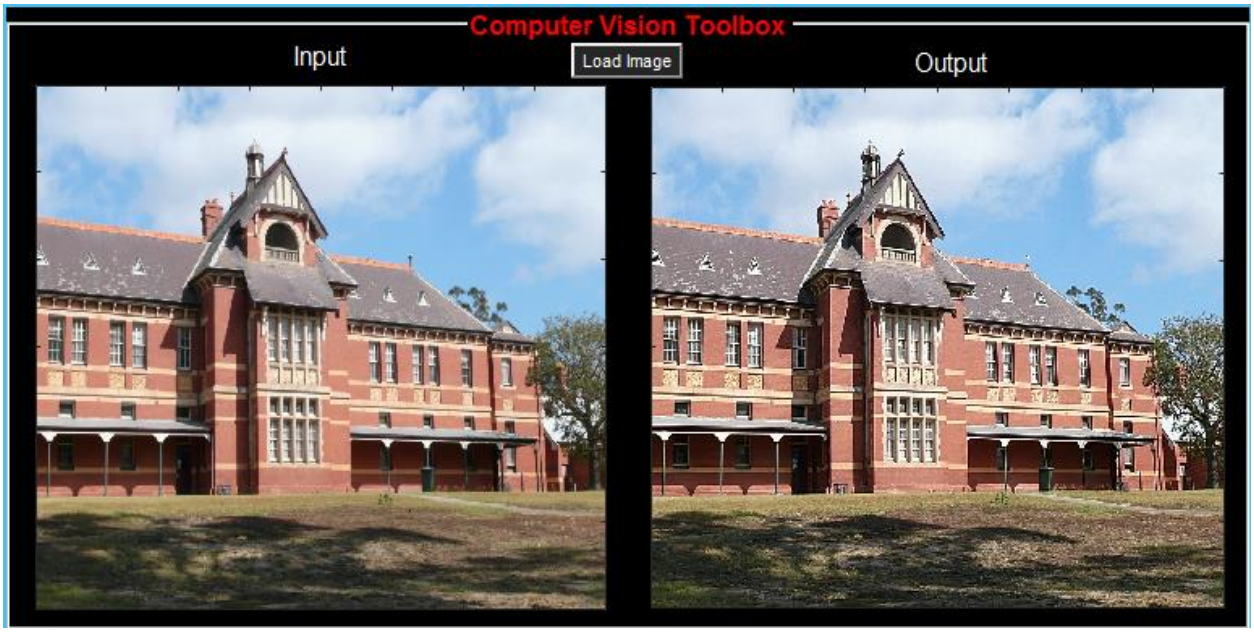


*Figure 23: Sharpening operation on image*

## 12. Edge Detection

In "Edge Detection" panel, we are using Canny Edge detector algorithm to find edges in the image. The output after applying the edge detection using canny can be clearly seen in the output panel.


*Figure 24: Edge Detection Panel*

## 13. Hough Transform

In "Hough Transform" panel, you can find lines and circles with Hough Transform method. By choosing find method Lines or Circles. The output after applying the Hough Transform method can be clearly seen in the output panel.


*Figure 25: Hough Transform Panel*

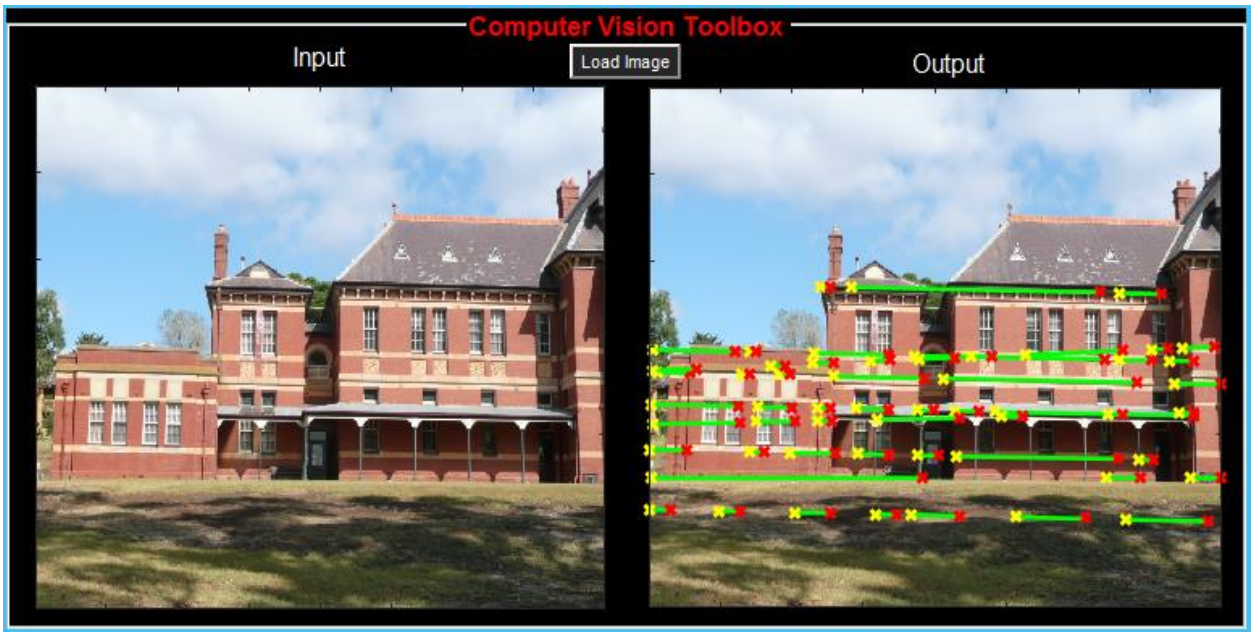


*Figure 26: Finding lines in Hough Transform on image*

## 14. Contour

In "Contour" panel, you can find contours of connected object and draw them onto image. There are many parameters available. The output after applying the Contour can be clearly seen in the output panel.

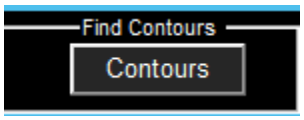


*Figure 27: Contour Panel*

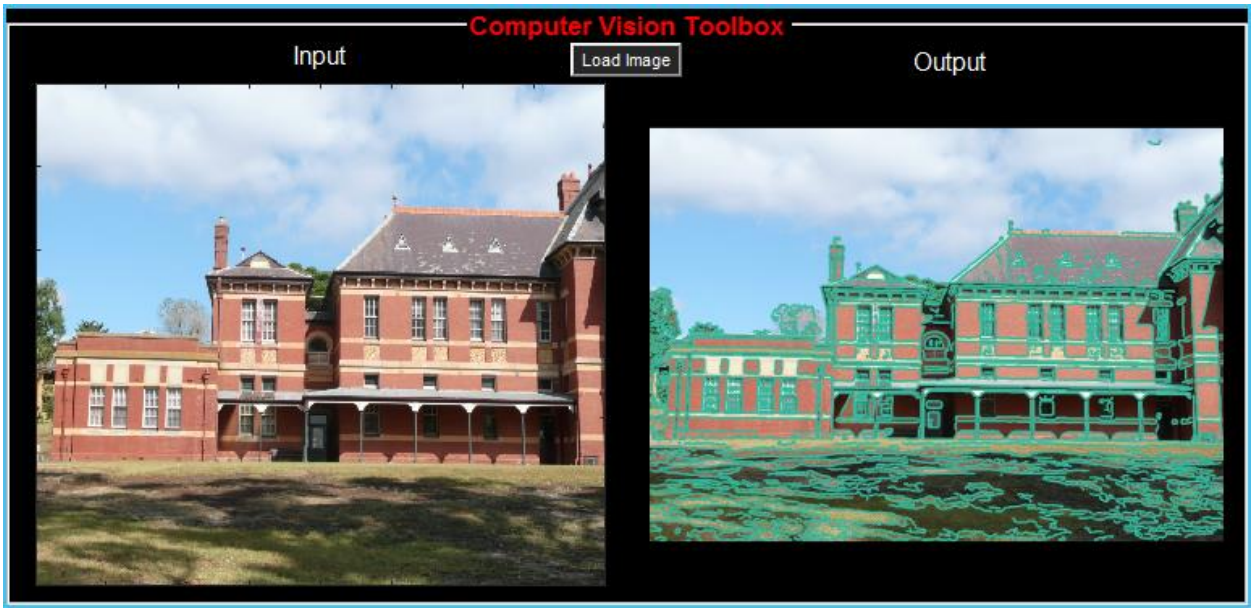


*Figure 28: Finding Contour on image*

## 15. Harris Corner Detection

In "Harris corner Detection" panel, you can extract corners with Harris Corner Extraction. The output after applying the Harris corner Detection can be clearly seen in the output panel.

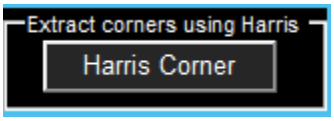


*Figure 29: Harris corner Detection Panel*

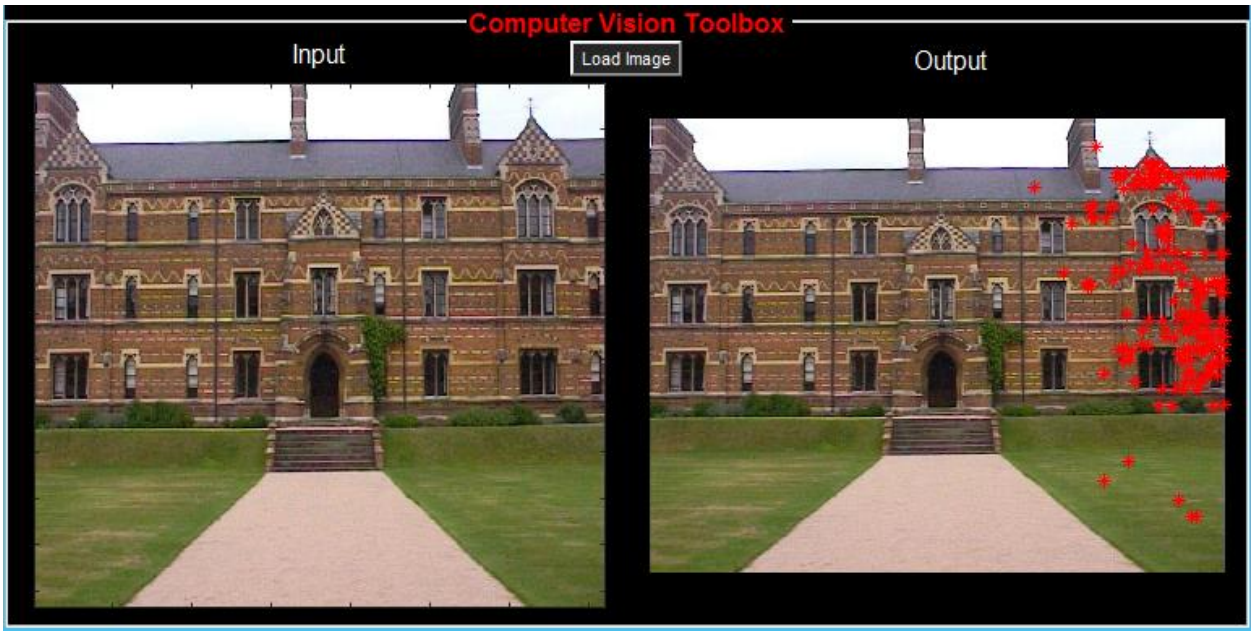


*Figure 30: Finding corners using Harris corner Detection in image*

## 16. Shape Descriptor

In "Shape Descriptor" panel, you can extract shapes with Shape Descriptor. The output after applying the Shape Descriptor can be clearly seen in the output panel.

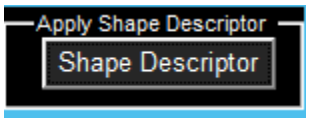


*Figure 31: Shape Descriptor Panel*

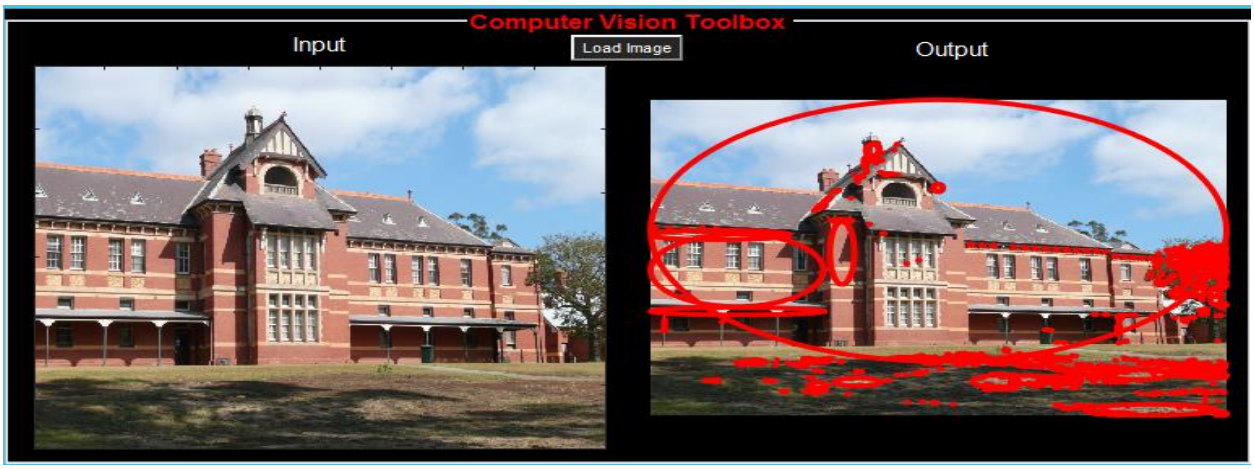


*Figure 32: Finding shapes using Shape Descriptor in image*

## 17. Features Extractor

In "Features Extractor" tab you can find 3 method implemented for key point extraction from current image.

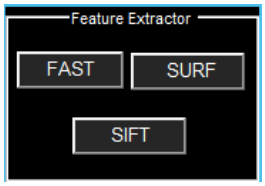


*Figure 33: Shape Descriptor Panel*

### FAST

Using "FastFeatureDetector" and given parameters, it finds key points and displays it on the screen. The output after applying the FastFeatureDetector can be clearly seen in the output panel.

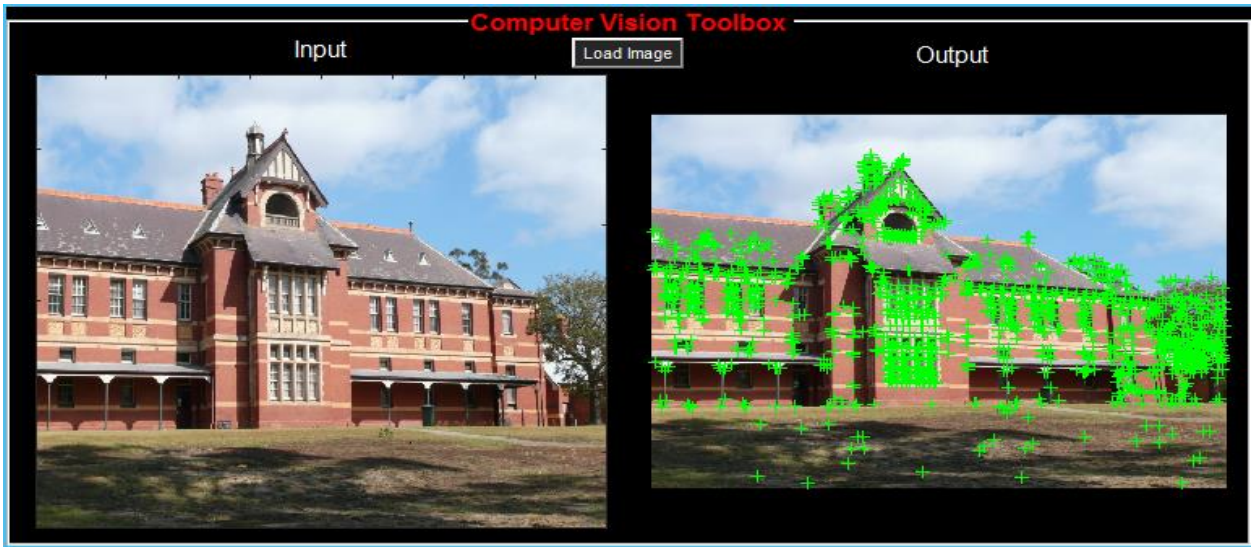


*Figure 34: Finding features using FastFeatureDetector in image*

SURF

Using "SurfFeatureDetector" and given parameters, it finds key points and displays it on the screen. The output after applying the SurfFeatureDetector can be clearly seen in the output panel.

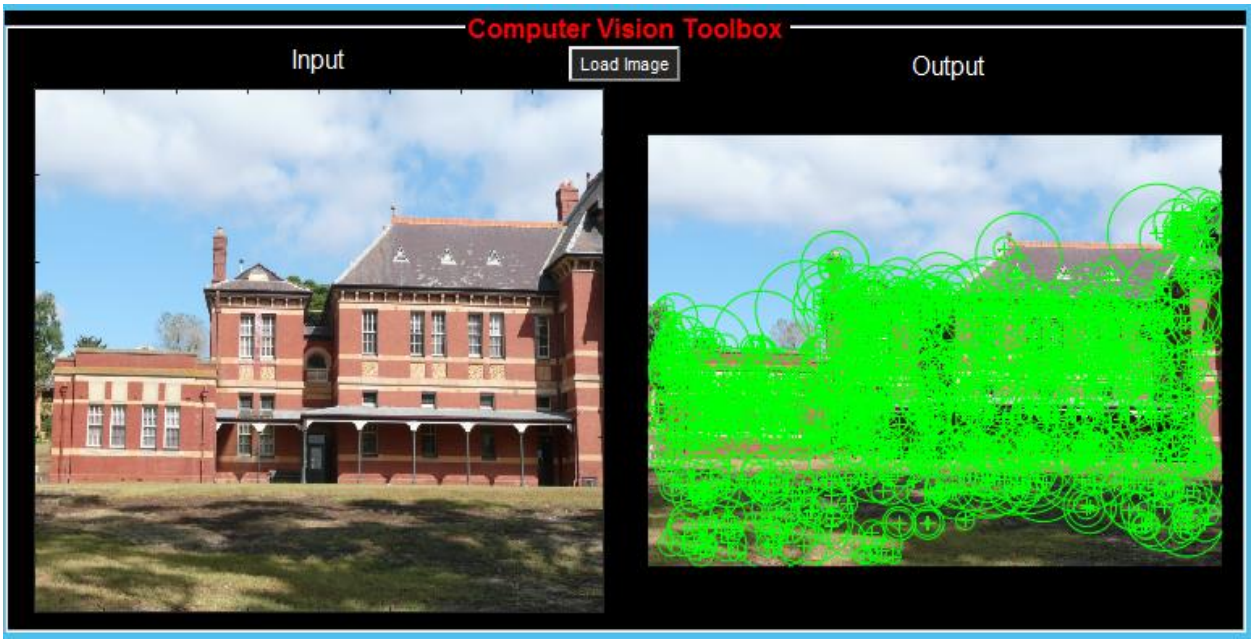


*Figure 35: Finding features using SURFFeatureDetector in image*

SIFT

Using "SiftFeatureDetector" and given parameters, it finds key points and displays it on the screen. The output after applying the SiftFeatureDetector can be clearly seen in the output panel.

## 18. Estimation

In "Estimation" panel, you can find many functions, including camera calibration, finding matches between images. Drawing epipolar lines, connecting two images with tomography and more.

## 19. Camera Calibration

In "Camera calibration" panel, Camera calibration is calculating the distortion for your camera and finding undistorted for better image acquire. The result of the calibration is saved in the code, and we can extract those parameters afterwards.

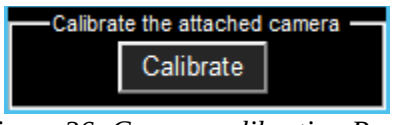


*Figure 36: Camera calibration Panel*

## 20. Find Matches

In "Find Matches" panel, we find matches between two images; first image and second image you will provide with "Upload Image 1" and "Upload Image 2". And a new window will open showing the matched features of both images. The output can be seen below,

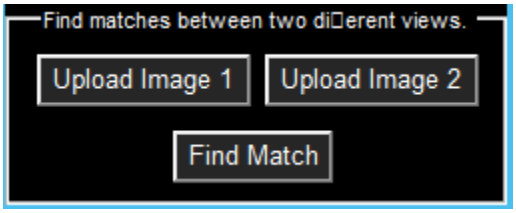


*Figure 37: Find Matches Panel*

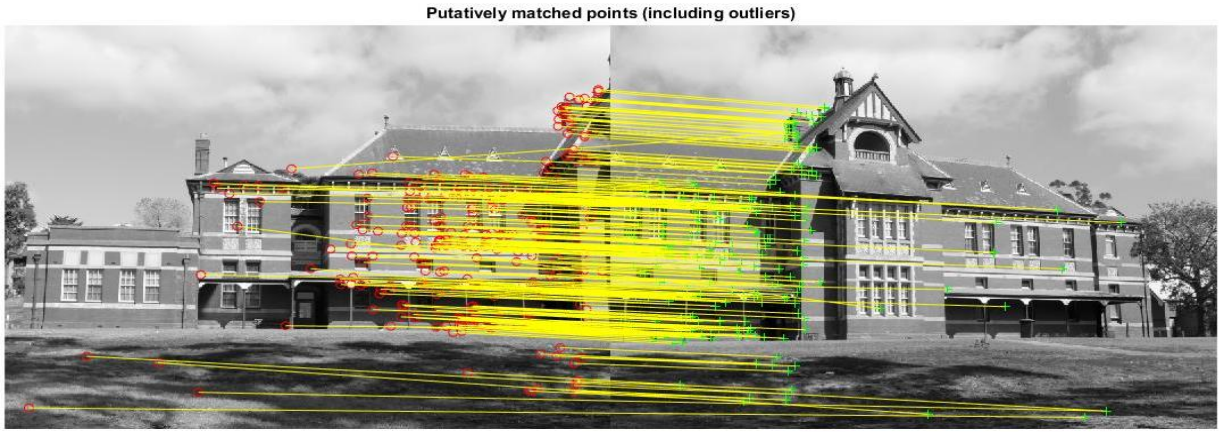


*Figure 38: Finding matches between two images*

## 21. Epipolar

In "Epipolar" panel, we finds and draws epipolar lines between two images; first image and second image you will provide with "Upload Image 1" and "Upload Image 2". And output will showed in both the axes showing the epipolar lines of both images. The output can be seen below,

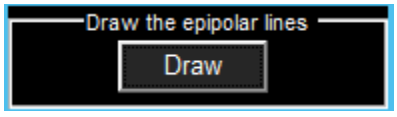


*Figure 39: Draw Epipolar Panel*

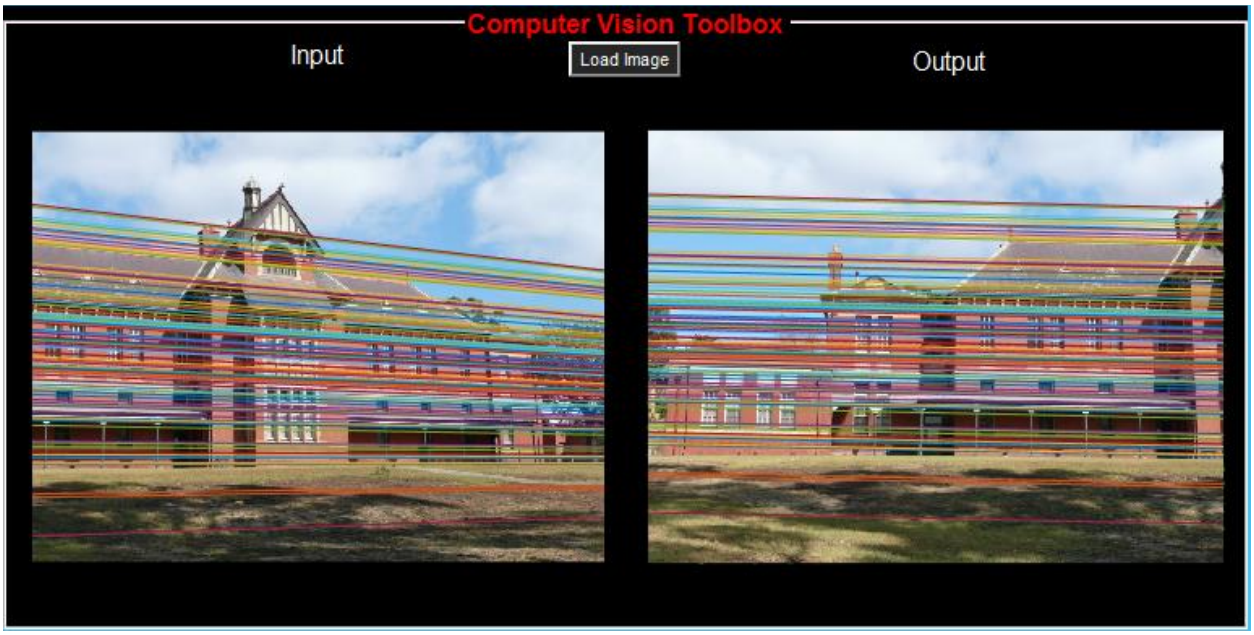


*Figure 40: Draw Epipolar lines between two images*

## 22. Fundamental Matrix

In "Fundamental Matrix" panel, we finds Fundamental Matrix of the images using 8-point method. And output will showed in command window of Matlab.

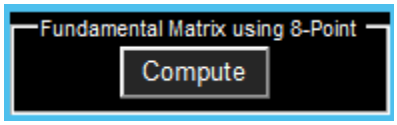


*Figure 41: Fundamental Matrix Panel*

## 23. Homography

In "Homography" panel, we computes the homography between two images first image and second image you will provide with "Upload Image 1" and "Upload Image 2" and connect them by the found homography. It joins both the images using homography and mosaicking. The output is clearly seen in below,

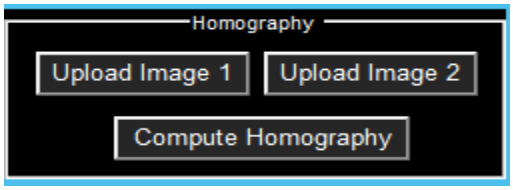


*Figure 42: Homography Panel*


*Figure 43: Mosaic Panel*

*Figure 44: Compute Homography and mosiac two images*

## 24. Stiching

In "Stiching" panel, we stitch given number of images, the images can be saved to a folder and we can upload the path of the folder and in the GUI, we can show images for stitching and the given images will be stitched when we press the stich button. As shown in the output picture shown below,


*Figure 45: Stitching Panel*

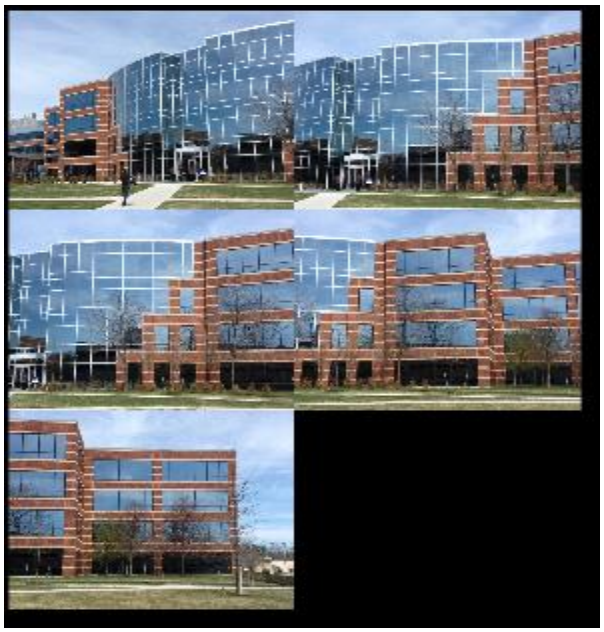

*Figure 46: Stitch number of images*

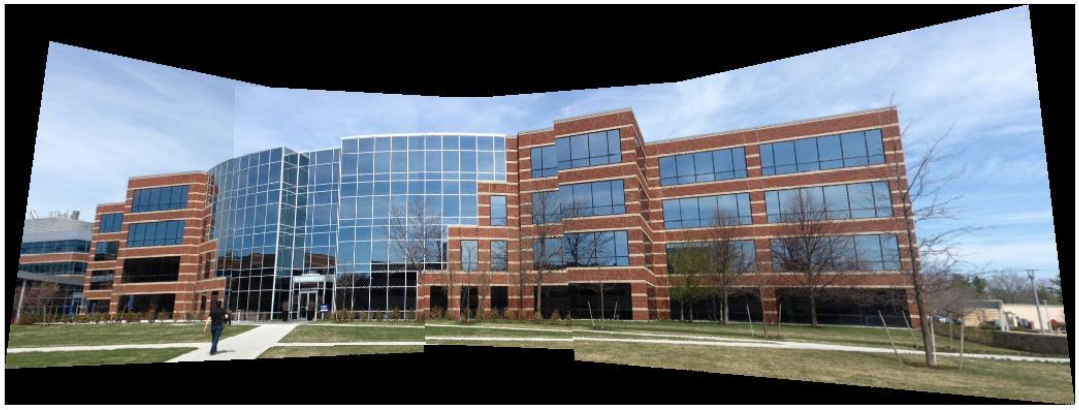

*Figure 47: Output Panorama after stitching number of input images*