Feature Detection and Matching with OpenCV

Exercises

1. As with the lab last week, run your python file using Python 2.7:

   ```
   C:\python27\python.exe
   ```

2. Import OpenCV, numpy and matplotlib

3. Download "GMIT1.jpeg" from Moodle into the same folder as your python file. Load the image into OpenCV

4. Using OpenCV, convert the GMIT image to grayscale Plot the output image to verify that it is indeed grayscale (as described in the previous lab):

5. Perform Harris corner detection on the grayscale input image. The function definition is:

   ```
   dst = cv2.cornerHarris(inputImg, blockSize, aperture_size, k)"
   ```

   where dst is the Image that stores the Harris detector responses. Set blockSize to 2, aperture_size to 3 and k = 0.04

6. Before plotting the detected corners on the img, create a deep copy of your original image so that you can draw circles on the corner pixels without affecting the original (look up online how to perform a deep copy in OpenCV - python). Call your deep copy something like: `imgHarris`

7. To plot the detected Harris corners, loop through every element in the 2d matrix – dst. If the element is greater than a threshold, draw a circle on the image as follows

   ```
   threshold = 0.XX; #number between 0 and 1
   for i in range(len(dst)):
     for j in range(len(dst[i])):
             if dst[i][j] > (threshold*dst.max()):
                     cv2.circle(imgHarris,(j,i),3,(B, G, R),-1)
   ```

   Experiment with different threshold values and set R,G,B to appropriate values to draw the circles.

8. Display the Harris corners – i.e. plot imgHarris

9. Next, we'll perform corner detection using the Shi Tomasi algorithm (also known as Good Features to Track (GFTT)). Corners are detected using the following function:

   ```
   corners = cv2.goodFeaturesToTrack(gray,maxCorners,qualityLevel,minDistance)
   ```

   Again, use the grayscale image as the input. Experiment with different numbers of maxCorners (this corresponds to the number of corners to be detected). Set qualityLevel to 0.01 and minDistance to 10.

10. Create another deep copy to protect the original image. Call the copy - imgShiTomasi

11. To plot the GFTT corners loop through the corners array and plot a circle at each corner as follows.

    ```
    for i in corners:
      x,y = i.ravel()
      cv2.circle(imgShiTomasi,(x,y),3,(B, G, R),-1)
    ```

    Again set appropriate values for R, G, B to plot the circles.

12. Plot imgShiTomasi to view the GFTT corners

13. Next, use the ORB licence-free version of SIFT to detect corners as follows:

    ```
    # Initiate ORB-SIFT detector
    orb = cv2.ORB()
    # find the keypoints and descriptors with ORB-SIFT
    kp1, des1 = orb.detectAndCompute(gray,None)
    # draw only keypoints location,not size and orientation
    imgOrb = cv2.drawKeypoints(imgOrb,kp,color=(B, G, R))
    ```

14. Plot imgOrb

15. Also, plot all images on a matplotlib subplot (as described in last week's lab)

16. Trial all the above with another image of your choice

Advanced exercises

1. Modify ORB so that it only returns 50 features at a maximum (rather than 500 which is the default). Consult the documentation online to achieve this.

2. Using the ORB detector and the code provided in the link below, demonstrate feature matching between the image above and the GMIT2.jpg image on Moodle.

Try either the BruteForceMatcher or FLANN method. Use the provided drawMatches function instead of the one provided in OpenCV2

```
from drawMatches import drawMatches
img3 = drawMatches(img1,kp1,img2,kp2,matches[:20])
```

http://docs.opencv.org/3.0-beta/doc/py_tutorials/py_feature2d/py_matcher/py_matcher.html#matcher

Demonstrate your results with another two images of your choice.