CS512 Assignment 4: Report

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November 29,2017

Abstract

Implementation of epipolar line construction using weak calibration and 8 point algorithm

Problem statement

- Two views of the same object is seen
- Point on one view is related to the other view
- The search space for the corresponding points on the views is limited to a line

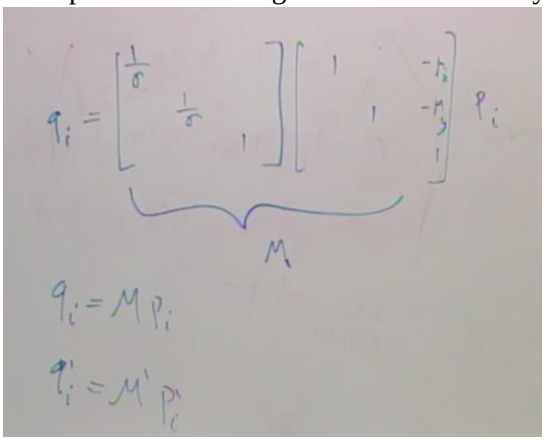
Proposed solution

Over view:

- Read two images from command line
- load them and display next to each other
- user clicks on corresponding points in the image through mouse
- normalizing each point
- Fundamental matrix of normalized points
- Ensure rank 2 matrix
- Fundamental matrix calculation
- Epipolar line calculation and drawing
- Epipole calculation

Normalizing points

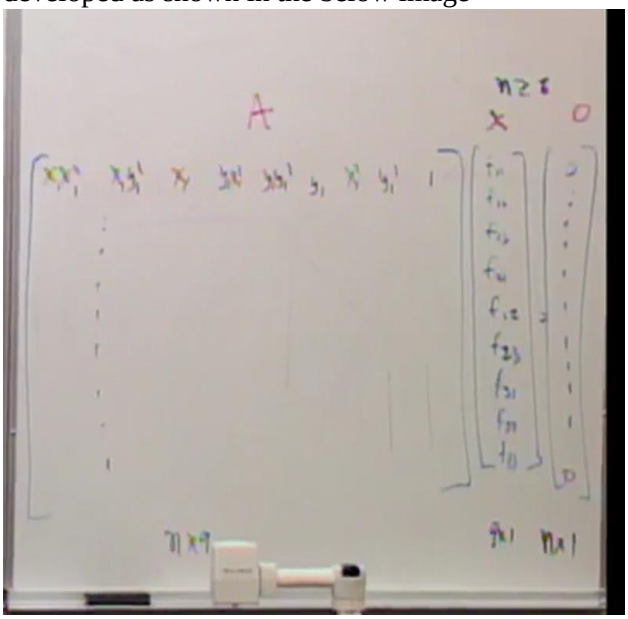
- Each point in each image is taken individually and normalized using M



- Mean and sigma are calculated for the points in each image and used as seen in above image to normalize points

Computation of fundamental matrix

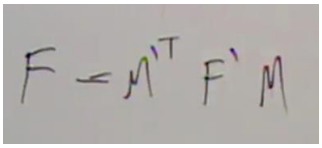
- Fundamental matrix for normalized points is found by taking svd on a system of equations matrix developed as shown in the below image



- Right null space of A is the fundamental matrix
- Fundamental matrix is ensured to be Rank 2 by making the last element of D to zero and the matrices are recombined to form A
- Svd is performed on this again whose right null space represents the 2rank fundamental matrix of normalized points

Computing Fundamental matrix of original points

- Using the relation shown below we compute the fundamental matrix from Fprime which is fundamental matrix of normalized points



Epipolar line is construction

- **Left epipolar line and right epipolar line are computed as r and l**
- **l = F pl**
  - **where pl is the point selected in left image**
- **r = F transpose * pr**
  - **where pr is the point selected in the right image**

Current Implementation

- Input
    - Two views of the same object is taken
- User selects points on the image (8)
- Epipolar lines are bit off where it should be displayed

Future Enhancements

- Improving the implementation to better accuracy

Manual

Structure of manual:

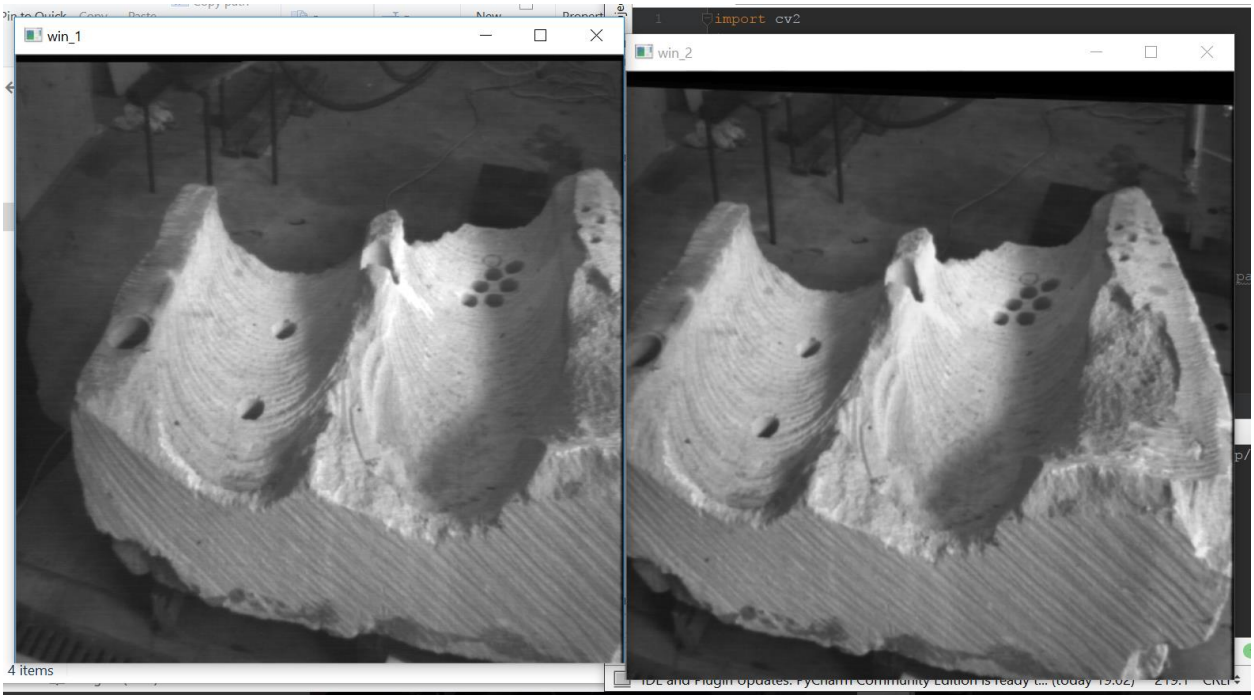
- Type of input description
- Command line arguments
- Input description
- Output

1. **Input provided as two images rock-l.tif rock-r.tif**
   command line arguments : <leftimage> <rightimage>
2. **Manual selection of points**
   Select corresponding points on the left and right image displayed by double clicking on the images
3. **Press any key to move forward**
4. **Images are redisplayed for user point selection for epipolar line construction**
5. **On selection epipolar line will be displayed depending on the image on which points were selected**

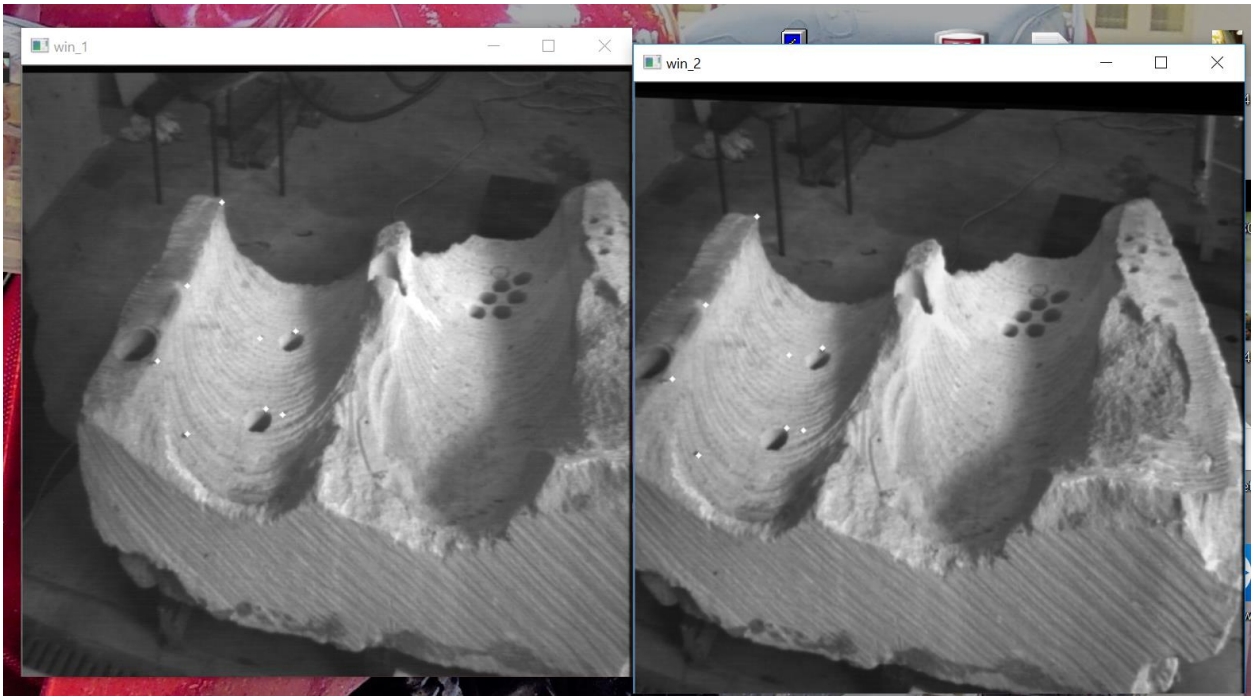
NOTE: user can select point on either left or right image

Example Results for various input options
Instruction to start the program :
“Python Main.py rock-l.tif rock-r.tif”

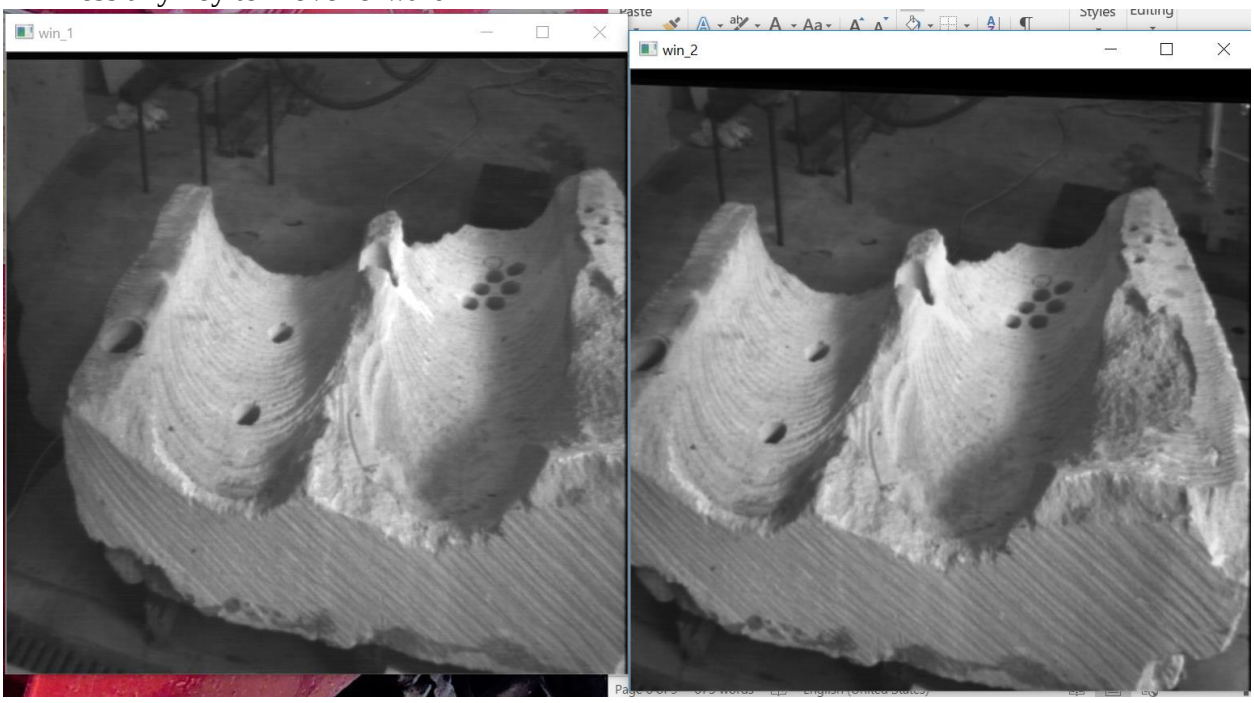
1. Input **rock-l.tif rock-r.tif**



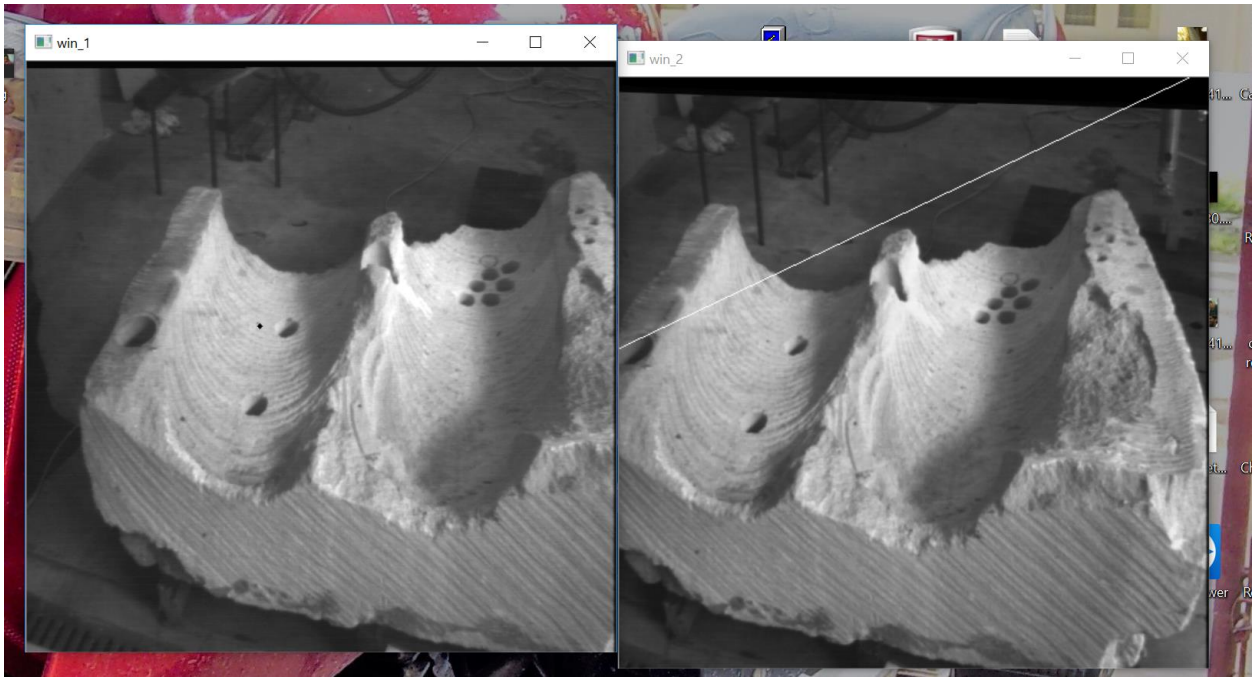
- Select the points by double clicking in the following pattern as follows: (selection is highlight with white color)

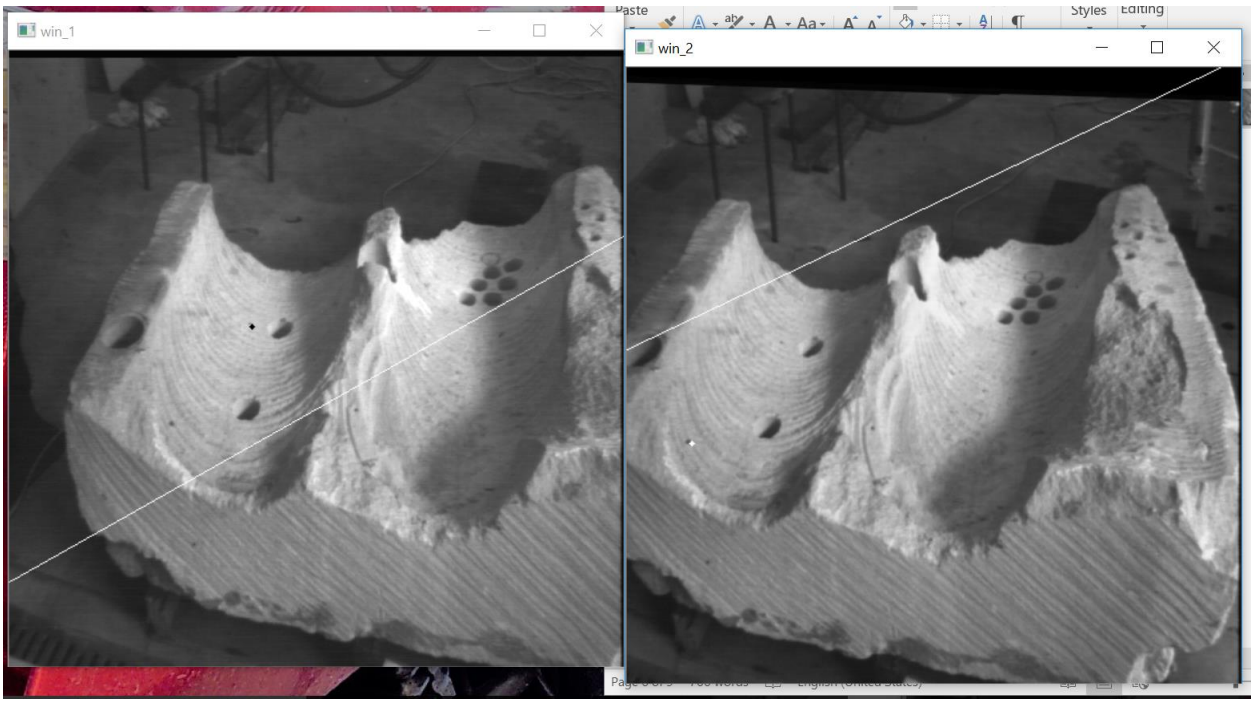


- Press any key to move forward



- New images are shown to input points for computation of epipolar lines
- Double click on either of the image
- Following image shows epipolar line construction when a point (black) is selected on the left image





Line construction when points are selected on both the images(black on left, white on right)

- Corresponding epipoles are seen in the console

```
left epipole {} -0.000685444791082
right epipole [] -0.000102903692904
left epipole {} -0.000685444791082
right epipole [] -0.000102903692904
```