

CS556: BONUS HOMEWORK 3
due 02/25/2016 at 1pm

Please submit your homework reports **in PDF format** to the TEACH website:

https://secure.engr.oregonstate.edu:8000/teach.php?type=want_auth

This bonus assignment will require your results from the regular HW3 for the **five** stereo pairs of images provided on the class website. For **each stereo pair** of images, perform the following additional tasks:

Assignment

1) (5×1 points)

- 1.1) Identify two different planar surfaces that appear in the stereo image pair. For each planar surface $l = \{1, 2\}$, manually select $N_{man} = 10$ pairs of corresponding points in the images **that lie on the same planar surface in the scene**, as precisely as possible, and record their coordinates:

$$\{([x_{kl}, y_{kl}], [x'_{kl}, y'_{kl}]) : k = 1, \dots, N_{man}, l = 1, 2\}$$

- 1.2) Estimate the two homography matrices $H_l^{(0)}$, $l = \{1, 2\}$, based on the corresponding N_{man} point pairs, and **present $H_l^{(0)}$ in your PDF report.**

2) (5×2 points)

- 2.1) Use the result \mathbf{z} of the regular HW3 for many-to-many matching of 100 strongest SURF interest points in each image:

$$\max_{\mathbf{z}} \mathbf{w}^\top \mathbf{z}, \quad \text{s.t. } \|\mathbf{z}\|_2^2 = 1, \quad \mathbf{z} \in [0, 1]^{100 \times 100}, \quad (1)$$

From your binary solution \mathbf{z} , automatically select N_{SURF} best pairs of SURF matches (i, j) for which the homography holds:

$$(i, j) : z_{i,j} = 1 \quad \text{and} \quad [x_j, y_j, 1]^\top - H_l^{(0)}[x_i, y_i, 1]^\top < \epsilon_l \approx 0 \quad (2)$$

where H_l is the homography matrix, $l = \{1, 2\}$, that you estimated using the N_{man} manually selected pairs of points. Select the value of ϵ so that $N_{\text{SURF}} = 10$.

- 2.2) Merge the two sets of N_{man} manually selected and N_{SURF} SURF point pairs, and thus obtain the new set of $N_l = N_{man} + N_{\text{SURF}} = 20$ point pairs. Re-estimate the homography matrix H_l based on these N_l point pairs, and **present H_l in your PDF report.**
- 3) (10 points) Formulate the objective function of a new many-to-many matching of the 100 strongest SURF interest points found in HW3 for each image, such that the objective function incorporates SURF similarities \mathbf{w} and fundamental matrix F along with your homography matrices H_1 and H_2 . (Hint: the formulation should be very similar to the one given by (1)). Present your formulation in your PDF report.
- 4) (5 points) Solve \mathbf{z} of your new matching formulation. In your PDF report, compare your new solution of \mathbf{z} with the one you solved in the regular HW3.
- 5) (2 points) Printout of the software that you used for this homework assignment.

Summary of Your Report

- $5 \times 2 = 10$ homography matrices $H_l^{(0)}$ based on the $N_{man} = 10$ manually selected point pairs.
- $5 \times 2 = 10$ homography matrices H_l based on the $N_l = N_{man} + N_{SURF} = 20$ point pairs.
- New many-to-many matching formulation.
- 5 solutions of the new many-to-many matching \mathbf{z} , and comparison with the corresponding solutions from HW3.
- Printout of the software.