CS685 Homework 6

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1. The increased size of the filter results in more blurry image.

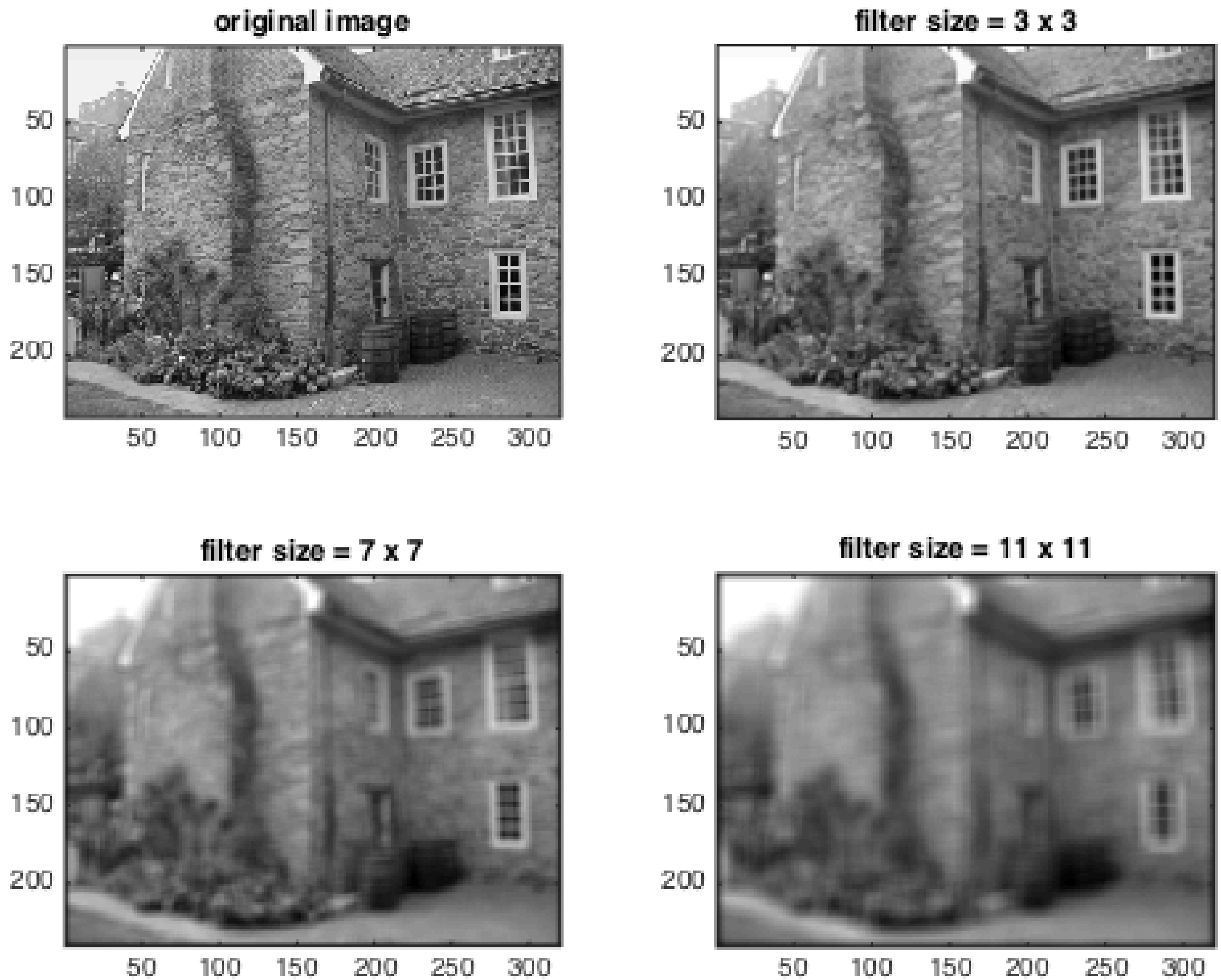

Figure 1: house1.jpg under the effect of the filter. The increased size of the filter results in more blurry image.

2. For the edge detection, the number of components decreases when the threshold increases. The results for house image are as follow.
    - threshold = 0.0, number of connected components = 14032.
    - threshold = 0.3, number of connected components = 1597.
    - threshold = 0.7, number of connected components = 82.

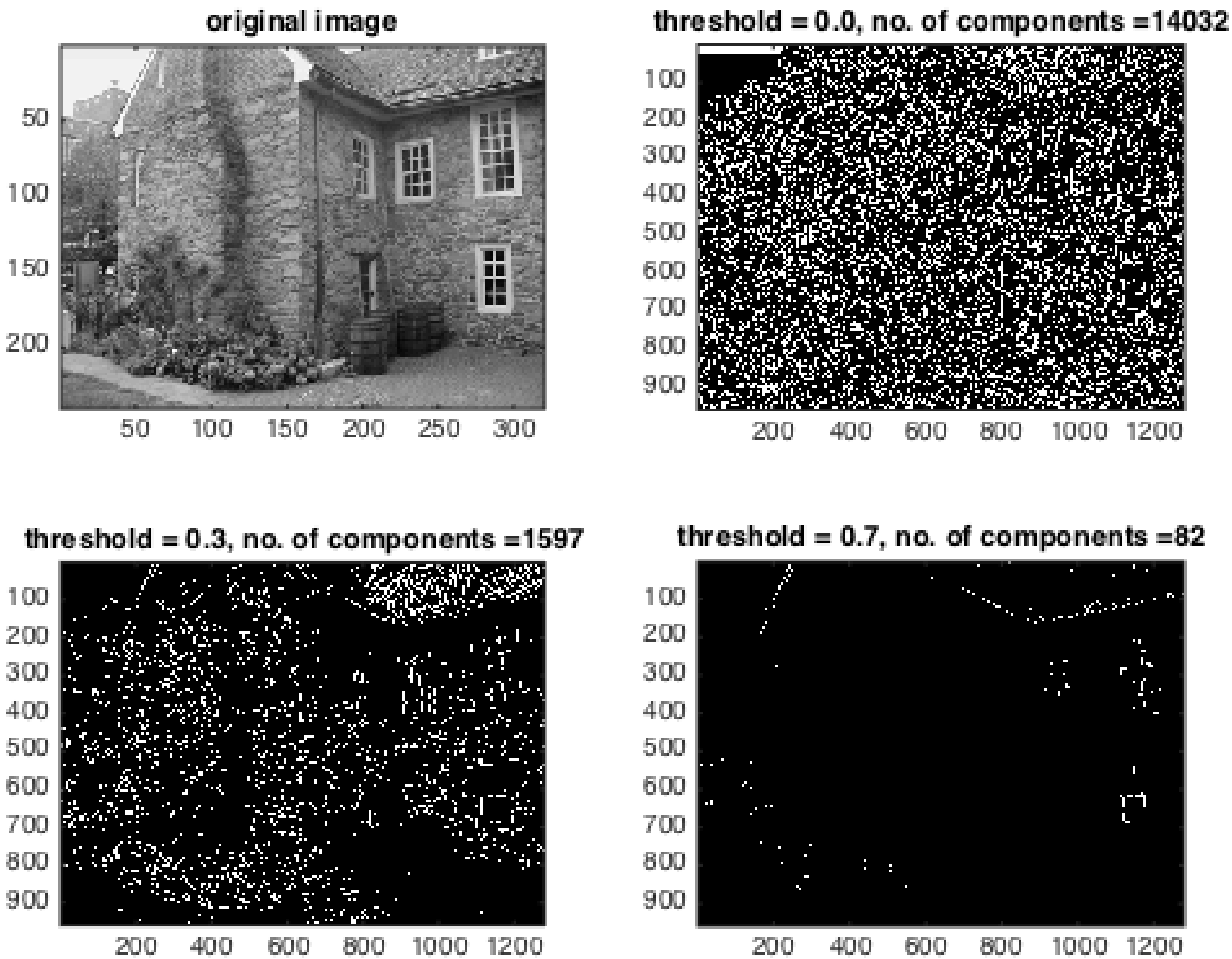

Figure 2: Edge detection on house1.jpg.

3. (a) According to our results in Fig. 3, If we rotate the input image, the detected corner positions rotate by the same amount.

   (b) According to our results in Fig. 3, If we scale down the input image, the corner detector will generate different positions, rather than scaling accordingly,

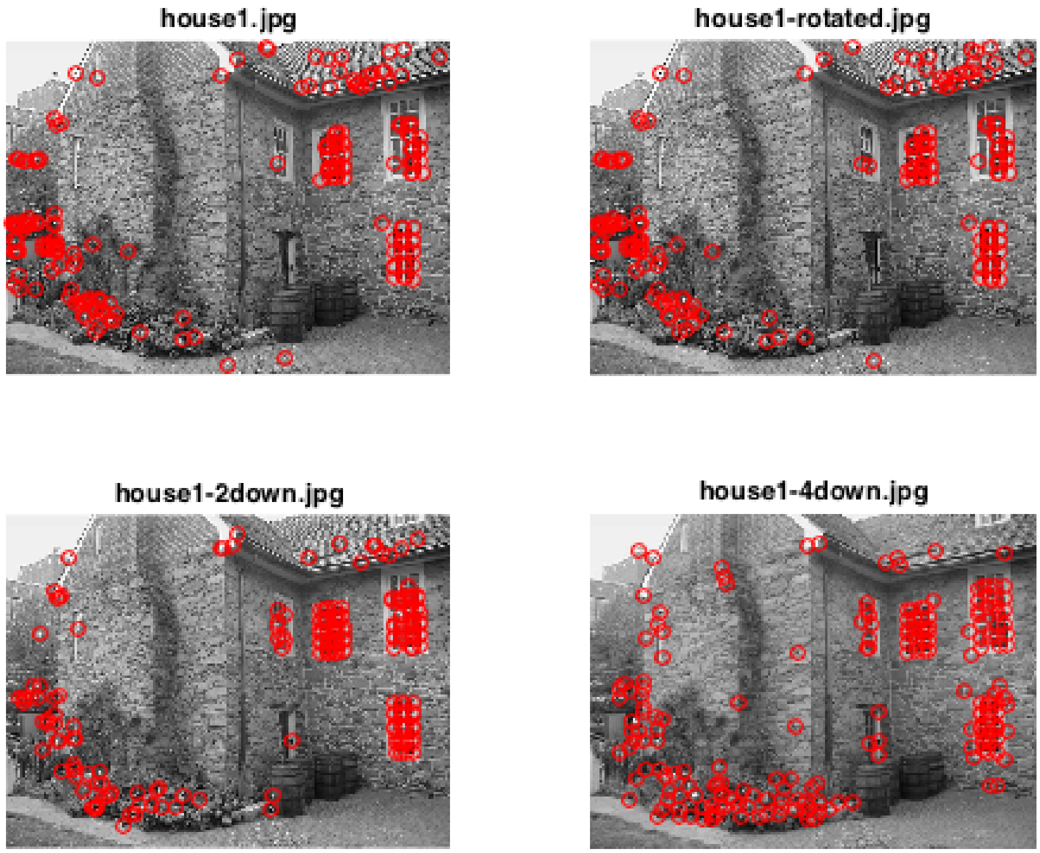

Figure 3: Harris corner detector house house images. The result for house1-rotated.jpg is re-rotated back for display.

4. (a) Results are shown in Fig 4. The window size for SSD is 5x5.

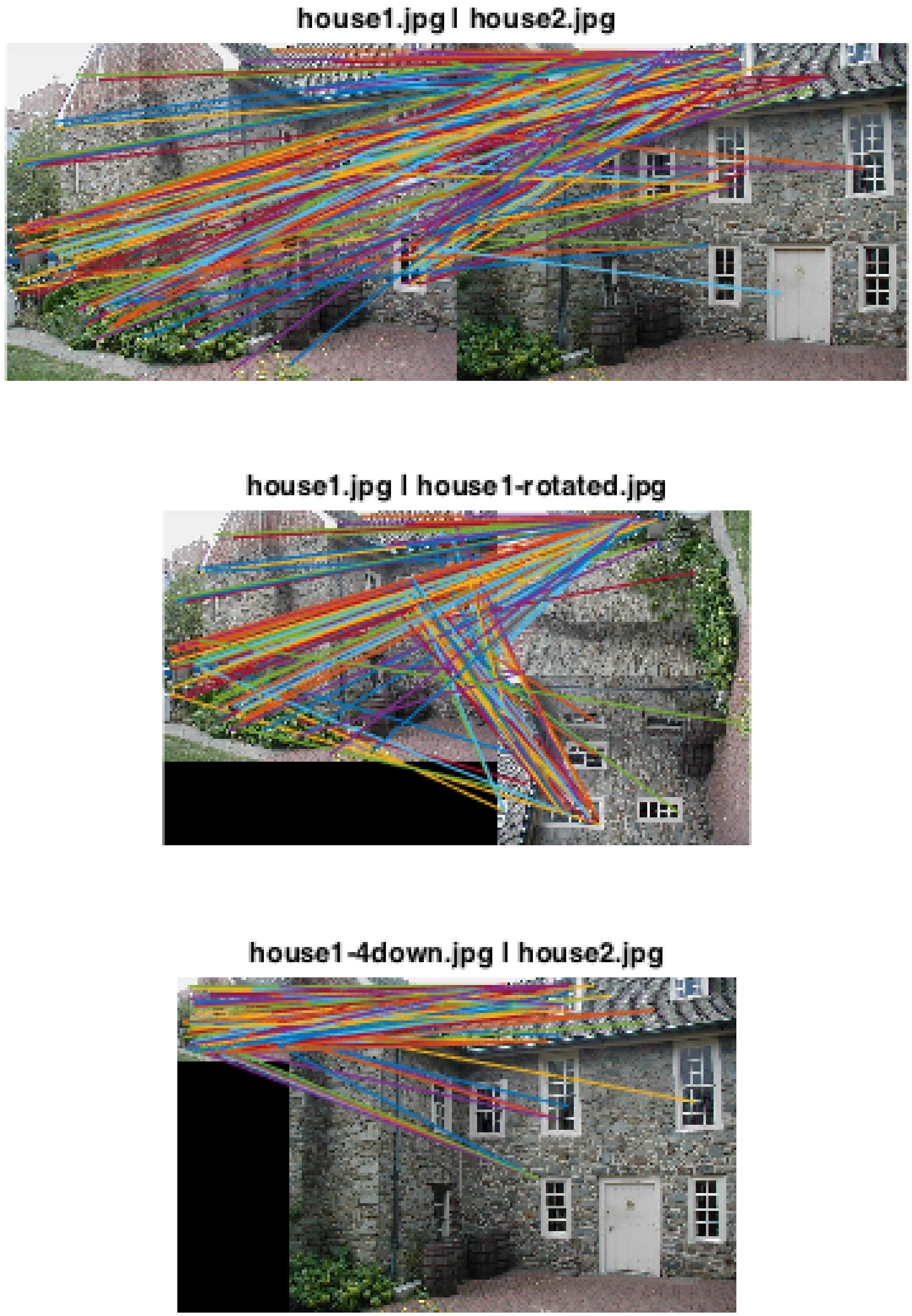

Figure 4: SIFT results.

(b) Results are shown in Fig 5.

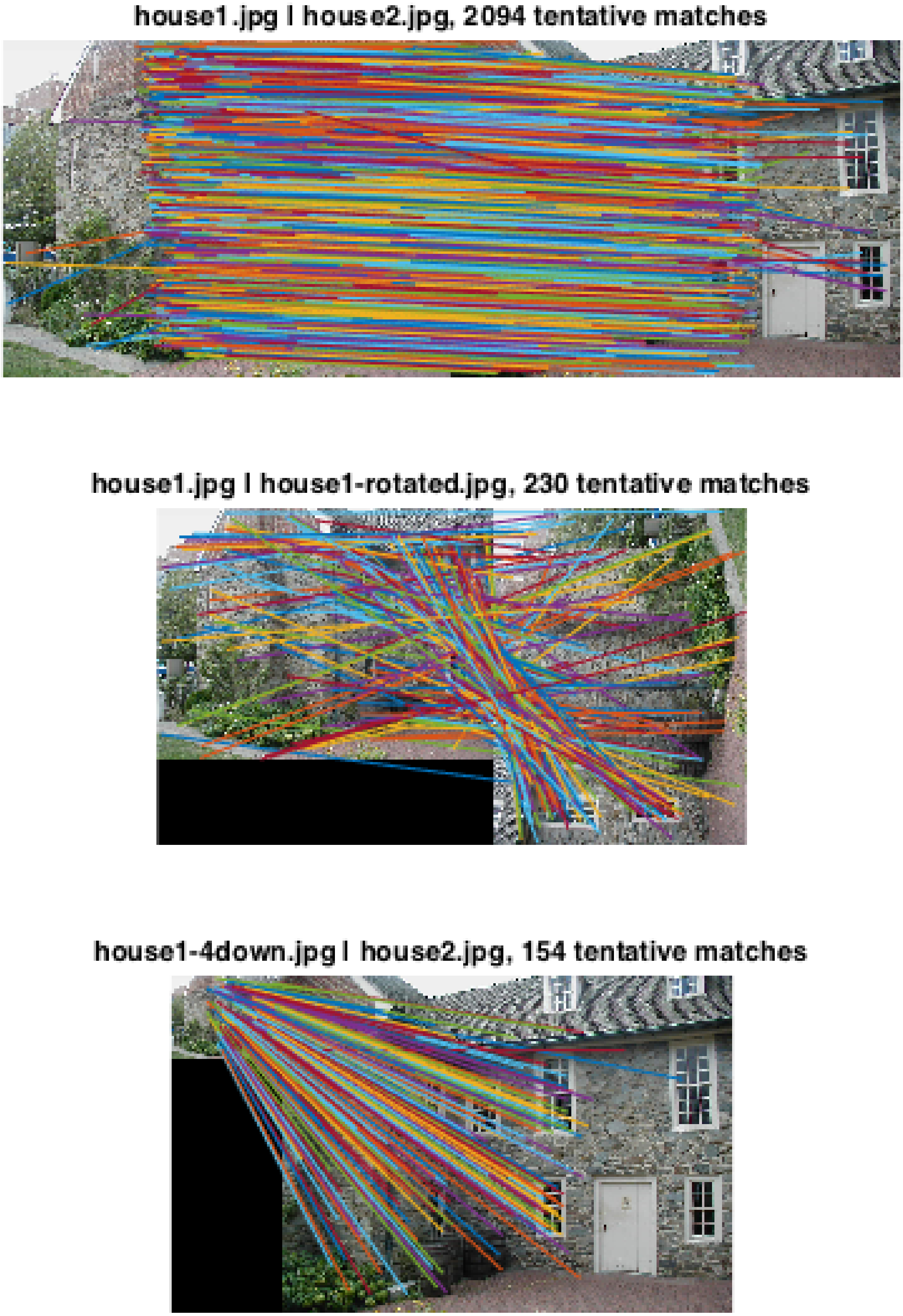

Figure 5: SIFT results.

(c) This algorithm is based on the observation that if the queried object appears in a image in the dataset. The positions of matching SIFT features will form a dense cluster, which distinct itself from other images. The algorithm is described as follow:

- Compute the SIFT feature for each image in dataset I that matches the queried image. The positions of these matching points for image i (in I) is a set denoted as P_i.
- Use Spectral Clustering[1] algorithm to cluster set P_i into **two** subsets. Calculate the average the pair-wise euclidean distances **within** each subset. The two average distances are denoted as d_i^+ and d_i^- and $d_i^+ < d_i^-$, and the subsets are denoted as P_i^+ and P_i^- respectively.
- Calculate $r_i = \frac{d_i^+}{d_i^-}$ for each image, and the results are in a set $R = \{r_i\}$.
- Use K-means to cluster set R_i into **two** subsets. Find the subset with lower r value, denoted as R^+.
- Return the image set I^+, which has the same index i as r_i in R^+.

Note: there is a limitation in this algorithm, that it assumes the querying object only appears at most once in each image in the dataset.

References

[1] Andrew Y. Ng and Michael I. Jordan and Yair Weiss, *On Spectral Clustering: Analysis and an algorithm*, ADVANCES IN NEURAL INFORMATION PROCESSING SYSTEMS, 2001.