

Image Alignment

In this assignment, you will experiment with a toy image alignment problem. You will use the provided Lena image throughout the assignment (also shown below – use the provided image file in your assignment, not the one below for display).



Your step-by-step tasks and questions are below:

- (1) Reduce the size of the original image by a factor of 2. Display the resulting image. What is the geometric transformation to this effect? Write it down.
- (2) Rotate the rescaled image of step (2) by 30 degrees in the clockwise direction. Display the resulting image? What is the geometric transformation to this effect? Write it down.
- (3) Write down the combined transformation, i.e., the one that first rescales the image down by a factor of 2, then rotates the rescaled image by 30 degrees in the clockwise direction.
- (4) Apply the combined transformation directly to the original image. Display the resulting image. Is it different than the one you obtained in step (2) (*Hint*: It shouldn't be!). Explain any observed differences.
- (5) Run your favorite interest point detector (e.g., Harris) on both the original and the transformed images. Display the identified interest points overlaid on the images.
- (6) Find correspondences between the keypoints found in step (5). Visualize your results. Comment on correct and especially incorrect matches.
- (7) Eliminate wrong matches by an automated procedure (e.g., applying 1NN/2NN distance ratio test). Visualize the results. Was the method successful?
- (8) Eliminate any remaining mismatches manually by visual inspection. Visualize the results.
- (9) Align the two images by a Least-Squares procedure using the pairwise correspondences as described in class. What is the unknown transformation model you used? (*Hint*: write

down the parametric model for first rescaling the image down by certain factor of s , then rotating it by 30 degrees in θ). Quantify the amount of error between the true transformation and the one you estimated by the LS procedure. Is it acceptable?

- (10) Transform the rescaled then rotated image back using the inverse of the transformation you estimated in step (9). Display your result side-by-side with the original image. Are the images aligned as they should be? Comment on any issues you observe.
- (11) How can you make the whole procedure? Discuss.