

CEG-7550 Computer Vision

Project 2: Stereo Correspondence

Handed out: 11/2/2017

Due: 11/30/2017, 11:00 AM

A stereo image pair and edges in the images are given. An example is given below. The images have been rectified so that corresponding points lie on the same scanline in the images. Find correspondence between edge pixels in the images and determine the disparity at the edge pixels in the left using the following algorithm.

Algorithm:

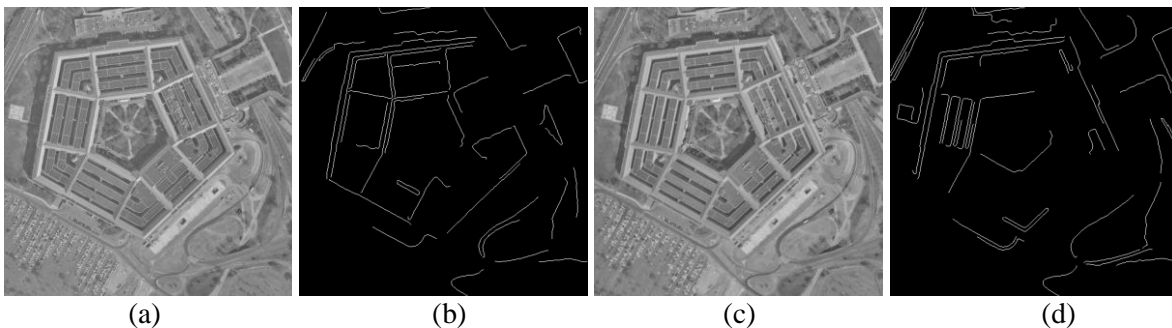
1. Identify possible correspondences: For each edge pixel (x,y) in the left image find edge pixels along the same scanline in the right image. Suppose there are n such edge pixels: $\{(x'_k,y): k = 1, \dots, n\}$
2. Find a match rating between (x,y) and (x'_k,y) for $k = 1, \dots, n$.
 - a. Find the similarity measure between the window centered at (x,y) in left image and the window centered at (x'_k,y) in right image.
3. Find the best-match correspondence: Let the window in the right image most similar to the window in the left image represent corresponding windows and compute disparity at (x,y) from $x'_k - x$.
4. Remove the ambiguous correspondences: If two or more edge pixels along a scanline in the left image correspond to the same edge pixel in the right image, keep the edge pixel in the left image producing the highest similarity and discard the remaining edge pixels.
5. Remove the weak correspondences: If a correspondence similarity is below a threshold value, such as 0.7, discard the correspondence.
6. Display the disparities: Map the disparities to $[64,255]$ and display them at the edges in the left image after setting non-edge pixels and edge pixels without a correspondence to 0.

Extra credit: Find correspondence between all points with gradient magnitudes greater than a threshold value, such as 3 or 5 (+5 point). Remove the incorrect correspondences by median filtering using 3×3 or 5×5 windows (+2 points).

Note:

- The similarity between two windows can be measured using the cross-correlation coefficient (CCC) or vector dot product after vectors of intensities are normalized to unit vectors.
- Typical window sizes are (columns \times rows): 3×7 , 3×9 , 5×9 , 5×11 , etc.
- Instead of Step 4, the left and right images can be switched, correspondences can be established between the edge pixels, and those correspondences obtained by both forward matching and backward matching can be kept and the remaining correspondences can be discarded to eliminate the ambiguous matches.
- To limit the domain of search, first find the minimum and maximum disparities between corresponding pixels in the images by manually clicking at corresponding pixels in the images. Make the range of disparities manually obtained an input to the program and use it to limit the search.

Write a short report (about 5 pages) describing your implementation, showing your results, and analyzing the results. If you are doing the extra-credit work, you may add a few more pages to your report.



(a), (b) A pair of stereo images. (c), (d) Edges in the images obtained by the Canny edge detector.