

Problem set 3

Due: Thursday, December 11, 2003

Stereo Algorithm: Write a stereo algorithm for a calibrated stereo system of your choice. Consult the paper “A Taxonomy and Evaluation of Dense Two-Frame Stereo Correspondence Algorithms” by Sharstein and R. Szeliski. An advanced algorithm consists of four steps, as described there: 1. matching cost computation, 2. cost aggregation, 3. optimization, and 4. refinement. You may implement an algorithm from the literature, or you may also try out your own ideas, or modify an existing algorithm with additional ideas.

Test your algorithm with the Tsukuba images and the Venus images, that is, estimate using your algorithm the disparity map for these two test images available at <http://www.middlebury.edu/stereo>. Print your (documented code) and the two disparity maps.

Discuss your algorithm: How does it perform in the non-occluded areas, near discontinuities, at occlusions, in textured areas and in non-textured areas?

Do you have some suggestions what could be done to tackle the chicken-and-egg problem of disparity estimation and occlusion detection? What could you do to obtain smoothness in the disparity map also in the vertical direction? How could you deal with very slanted surfaces, that is what could be done to distinguish between an occlusion and a slanted surface which covers areas of significantly different size in the left and right image? If you have ideas implement them.

On the last day of class (12/11) bring in your results and show them. Prepare a short presentation (a few minutes) and explain your technique. (Do you have an optimization step? How does it work?) Discuss possible improvements and your ideas to the above questions.

Problems

1. Consider a camera moving with rigid motion and fixating at the center. In other words, at the pixel $(x, y) = (0, 0)$ the optical flow is zero. What constraint do you get from the fixation. That is, how are rotation and translation related to each other?

2. We call a system with three cameras looking at the scene a trinocular stereo system. What advantage do you get from using a third camera. Suggest some ways to utilize the additional information in stereo reconstruction.
3. Question 7.7 from Trucco and Verri
4. Exercise 7.3 from Trucco and Verri