Exercise Stereo Matching

August 9, 2010

1 Exercises

Implement in MATLAB a correlation-based stereo algorithm that takes as input a pair of rectified stereo images and outputs a disparity map with the same dimensions as the input images. Sample left and right images are in the assignment folder.

Your function should look like:

function dmap = corr stereo(imL, imR, wsize, maxd);

This function outputs the disparity map dmap which matches from left to right; dmap should be the same dimensions as the original image. The function takes wsize a correlation window size and maxd an upper bound on the disparity.

The function should use the sum of squared distance (SSD) metric Eq.1 you can initially start with correlation window size of 5x5

$$\sum_{x,y \in W} \left(I_R(x,y) - I_L(x+d,y) \right)^2 \tag{1}$$

2 Details

The task can be done using nested for-loops however multiple nested loops in MATLAB will take a long time.

For the brave instead, compute an image of squared differences and use convolution **corr2** (using a wsize x wsize mask of ones) to add everything up. You'll be doing this for every possible disparity value in the square region defined by maxd, stacking up the matrices for each, and using min(:,:,3) to select the disparity that minimizes the SSD.

3 Presenting

Be prepared to discuss the implications of the following modifications:

- Try different values of maxd (a good value to start with is 15).

- Try different window sizes (wsize). Start with a 5x5 window.

- Use SAD (sum of absolute differences – an L1 norm) instead of SSD (L2 norm).

- Try filtering the images with a Gaussian kernel first (you'll want to adjust wsize based on the size of the kernel).

  ```
  fspecial('gaussian', hsize, sigma)
  ```

- Try filtering the images with a Laplacian kernel

  ```
  fspecial('log', hsize, sigma)
  ```

  first (similarly adjusting width of filter).

Describe and explain the effects on the results in your presentation on Friday.

4 Extra Credit

Implement left-to-right consistency with the function **dmap = stereo_corr_lr(left, right, wsize, maxd)**. This computes the disparity map for left-to-right and right-to-left, and only keeps the disparity value there if they are in agreement (their horizontal offsets will be negated). If they disagree, the disparity is set to zero. Describe the effects this method has on the results.