CS 223b: Introduction to Computer Vision
Assignment #3: Stereo
(out of 25 points)

Due date: Monday, February 2nd, 2004 (no extension)
N.B.: You are not allowed to work in teams on this assignment.
Recommended readings: *Trucco and Verri* Chapter 7

1 Correlation based stereo (20 pts.)

(a) **(15 pts.)** 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. Your function should look like:

function dmap = corr_stereo(imL, imR);

There are a number of design choices and optimizations to be made in such an open-ended assignment. You will be graded not only on how well your algorithm works, but also on its efficiency and the various

Fig. 1: An example of a rectified stero pair.

design choices you make. Each time you make a particular implementation choice, we'd like you to justify it. In particular, we'd like to know

1. What are the advantages of this choice?
2. What are its disadvantages? In what situations will this choice backfire?

Sample stereo pairs can be found on the class website at:

http://robots.stanford.edu/cs223b/homework/hw3/

(b) **(5 pts.)** Assume that this stereo pair was imaged with two separate cameras, C_l and C_r. Given the intrinsic and extrinsic parameters for both cameras, write a MATLAB function that takes the two sets of calibration parameters along with a disparity map and turns it into a range map. Your function should be of the form:

function rmap = d2r(dmap,R1,T1,fx1,ox1,oy1,alpha1,R2,T2,fx2,ox2,oy2,alpha2);

where the calibration parameters are input in the same form as they were output from **calibrate** in Assignment #2.

(c) **To hand in:** you are responsible for handing in the following:

1. An electronic copy of your MATLAB m-file for calibration called **corr_stereo.m**
2. A text file called **answers_hw3.txt** with your description of **corr_stereo** and justification of your design decisions.
3. An electronic copy of your MATLAB m-file for creating a range image called **d2r.m**

2 Short answer (5 pts.)

(a) **(1 pt.) What are the main advantages and disadvantages between correlation-based stereo and feature-based stereo?**

(b) **(1 pt.) Define the epipolar constraint. How does it help speed up solutions to the correspondence problem?**

(c) **(3 pts.) Can depth be recovered from a stereo pair taken under the following circumstances? Briefly justify your answers.**

- Two images produced by orthographic projection using two cameras with parallel optical axes?
- Two images taken by a single perspective projection camera that has rotated about its optical center?

(d) **To hand in:** you are responsible for handing in the following:

1. A text file called **answers_hw3.txt** with your answers to the previous questions together with your answers to these questions.

This work must be emailed to **cs223b@cs.stanford.edu** by 11:59:59 pm EST on the day the assignment is due.