

MEMORANDUM

To: Self, Dr. Randy C. Hoover
From: Sharif Anani
Subject: A summary of the stereo matching problem
Date: October 20, 2015

1 The Problem

The problem of stereo matching is the problem of finding corresponding points/pixels in a pair of images taken from a stereo pair.

This allows us to compute what is known as disparity, which will be discussed later in this memo.

2 Assumptions

In this problem, we are going to make some simplifying assumptions:

1. Both cameras are calibrated
 - (a) The intrinsic and extrinsic parameters of each camera are known
 - (b) The translation and rotation between the two cameras are known.
2. The matches are going to be done horizontally, because the images are rectified.

3 A brief introduction to epipolar geometry

Using the pinhole camera model and a virtual image plane **in front of** the center of projection, the projection of the center of projection of one camera onto the other camera's plane is called an *epipole*, and the line connecting the two points is called the *epipolar line*.

Rectifying images to align the epipolar lines makes the problem simpler, because features will lie on the same horizontal line in both images, which simplifies the search for matching features to compute disparity.

4 Feature Matching

After the images are rectified, there are numerous ways to find features. Features can be found using ORB, SURF, SIFT, edge based, or any of the other feature finding algorithms. To match the features, a simple method is correlate a patch around a feature on one image along the epipolar line of the other image, this generates a disparity (du, dv) where $dv = 0$ because the images were rectified.

5 Preprocessing Considerations

To obtain better matching and disparity maps, we can have the images undergo some preprocessing in order to improve feature extraction and matching. Such preprocessing can be Gaussian Smoothing or Histogram Equalization to improve contrast.