Disparity Introduction

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5/2/2018

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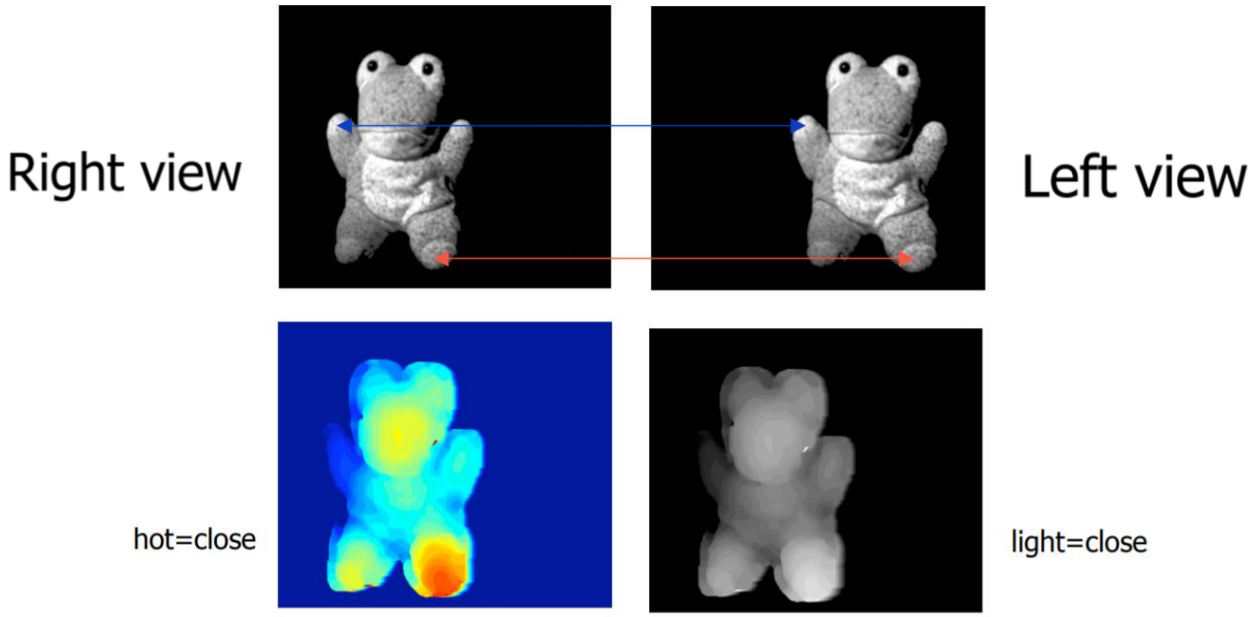
Why disparity estimation is important

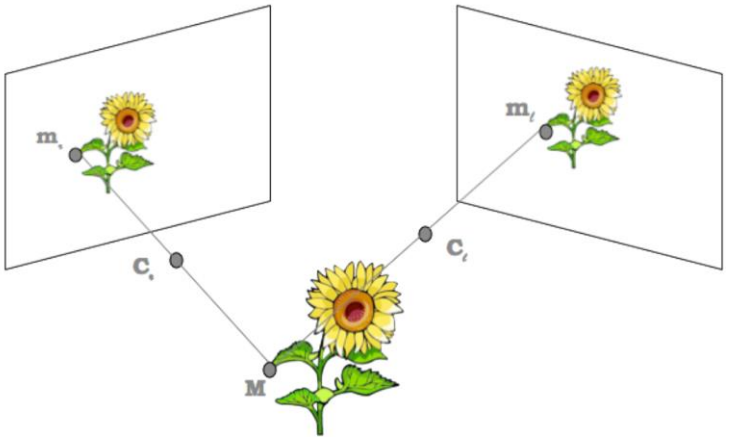
Stereo estimation is a fundamental computer vision:

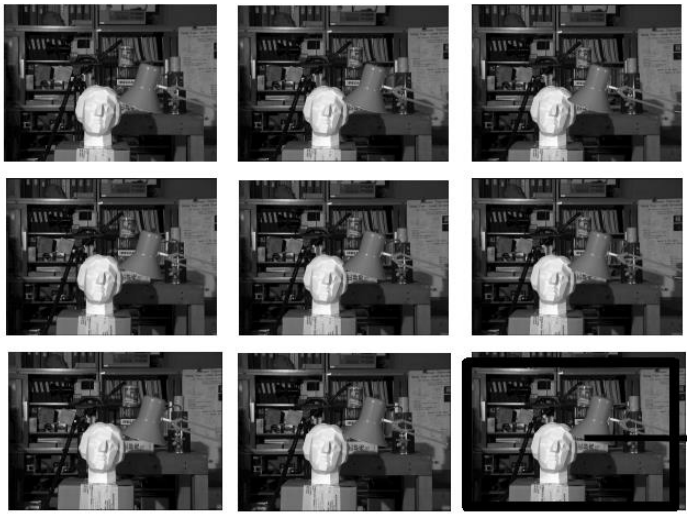
Given two images for the same scene from different views, compute the disparity for each pixel and then generate depth map.



Introduction of disparity

Binoculor v.s. Multi-view

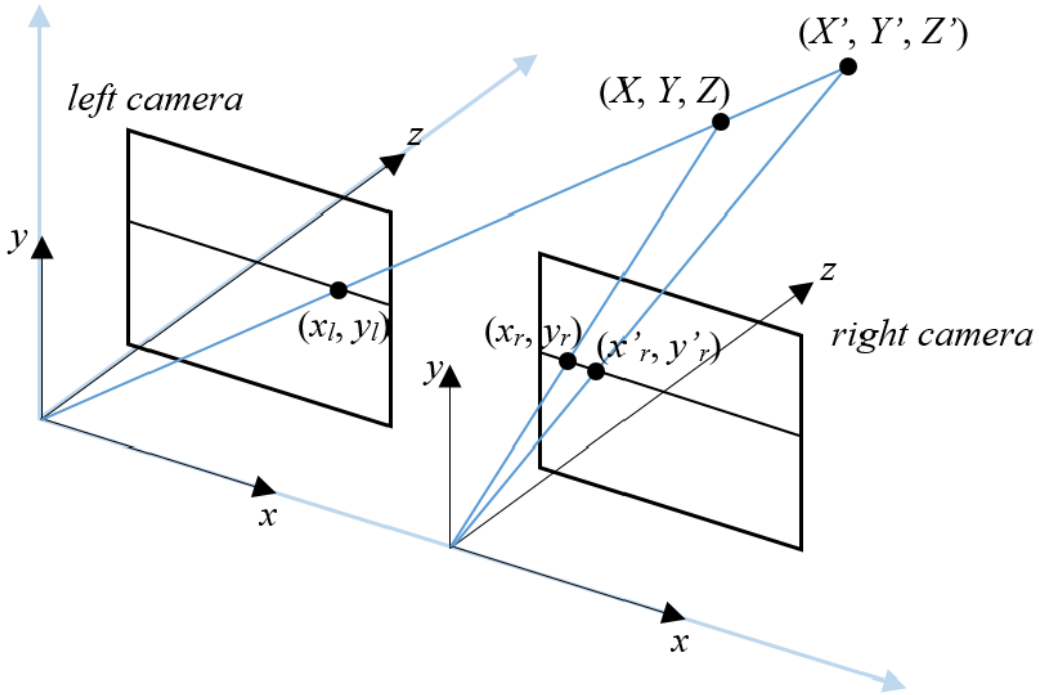




Binocular disparity is just 1-D estimation which may ignore some vertical information.

Multi-view disparity is the extension of binocular method at 2-D estimation, which uses more than two images.

Disparity in binocular

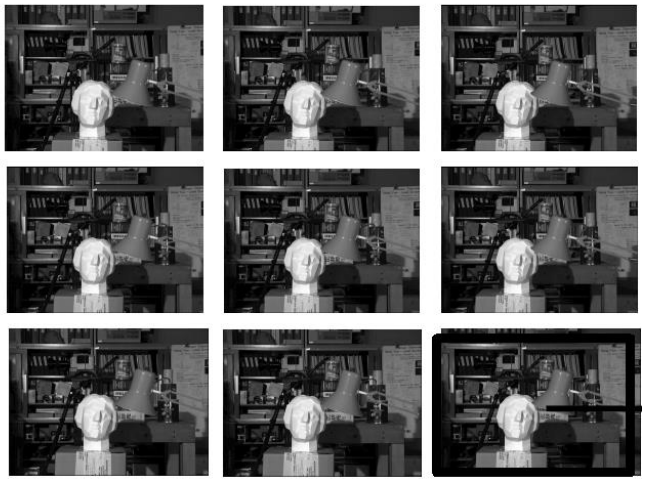


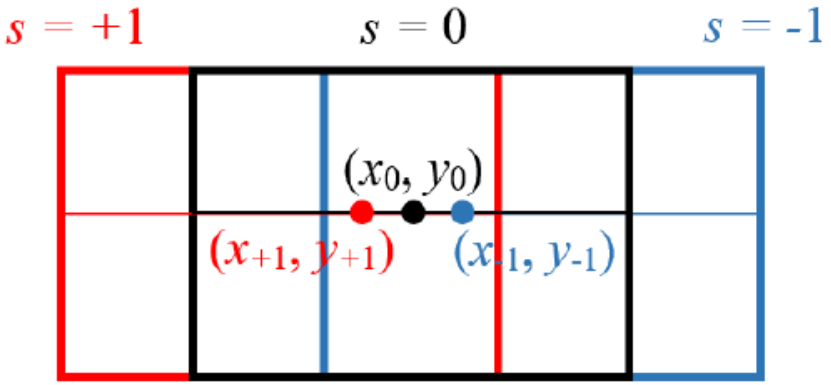
- The horizontal shift of the corresponding points in two images is called disparity.

$$x' = x + s\,d(x,y), \quad y' = y,$$

- S is a sign (±1) which ensures the disparity would always be positive.

Disparity in Multi-view





- s is used to denote the relative position between an image and the reference image(usually the center image)
- For each disparity d, the corresponding pixel intensity would be:

$$I_{s,t}^{d}(x,y) = I_{s,t}(x+(s-s_0)d, y+(t-t_0)d)$$

Basic Steps of disparity estimation

Basically, a stereo algorithm generally performs the following 4 steps[1]:

1. matching cost computation;
   - Relationship like distance between corresponding points
2. cost aggregation;
   - Smooth cost map
3. disparity computation / optimization;
   - To compute or predict the disparity for each pixel
4. disparity refinement.
   - Encourage discontinuity at edges of the an object
   - Encourage continuity at surface of an object