An Introduction to Stereo Vision and Disparity Computation

6.344 Final Project, Spring 2001
Edwin Olson (eolson@mit.edu)
Melissa Hao (mhao@mit.edu)
Roadmap

- Introduction
- Background
- Our Program
- Results
- Conclusions
Introduction

- Stereo Vision is perception of depth from two images
  - Humans take it for granted!
  - Very hard problem for computers.

Applications
- Industrial robots
- Object modeling
- Machine Understanding/Al
Problem boils down to finding corresponding points.
Similar to motion compensation problem in MPEG encoding.
**Our Program**

- Wrote MatLab program to perform block matching

**Inputs:**
- Two stereo images
  - Color can be exploited
- Blocksize

**Outputs:**
- Depth Map
- Confidence Estimate

**Performance**
- Awful! ... but we weren’t trying to be fast.
Confidence Estimation

- Block matching sometimes works great, sometimes does something dumb.
  - Noise, Occlusions, Specular highlights
- When it does something dumb, can we detect that?
  - Yes! For the same reason that Log searches work!
Confidence Estimation (2)

- Block matching works well when there’s a single “obvious” minimum.

- Tried Several Metrics:
  - minimumerror
  - averageerror / minimumerror
  - interpret as PDF, compute expected disparity error

- Works, but room for improvement
  - Typically too conservative
Block Matching (16x16) half-pel resolution, synthetic input.
Block Matching (16x16) half-pel resolution

left

right

depth

confidence
Block Matching (16x16) half-pel resolution
Block Matching half-pel resolution. Block size comparison.
Block Matching half-pel resolution. Use of Color.

Block Matching half-pel resolution. Use of Color. Poorly aligned images.
Conclusions

- Block Matching works quite well, but is computationally expensive.
  - Very good performance on regions with significant detail
  - Confidence estimates can give hints on where block matching did poorly.

- Lots of ongoing research
  - Neural nets
  - How do we make it faster?