Motivation

Two types of information exist in a stereo pair:
1) matched regions: depth
2) unmatched regions: location and magnitude of depth discontinuities

People can perceive depth even when matching information is absent or very weak:

However, state-of-the-art computer vision systems cannot:

Goal: design a scanline stereo system that
1) works on images with limited matching information
2) improves results in half-occluded regions of natural stereo pairs
3) inspire improvements to future 2D algorithms

Perceptual dataset

Toward perceptually-consistent Stereo: A scanline Study
Jialiang Wang, Daniel Glasner and Todd Zickler
Project site: vision.csae.harvard.edu/stereo

Correlation and Decorrelation Cues

In disparity space (cyclopean), we can identify the occluding contours and half-occlusion size using correlation gradients:
- A, C: occlusion-inducing boundaries
- B, D: half-occlusion boundaries

Scanline Formulation

Represent disparity profile as a piecewise smooth function determined by:
1) breakpoint locations $I = \{x_0, x_1, \ldots, x_T\}$
2) shape parameters in each smooth piece $(\theta_i)$

Minimize:

Dynamic Programming Optimization

For images that are not pure random-dots, such as the textureless plane stimuli:

Results

Perceptual dataset:

Our algorithm:
- recovers the correct disparities for 10 of 12 perceptual stereo pairs
State-of-the-art algorithms:
- can perform decently in some stereo pairs that have matching information
- fail completely when matching information is absent

Failure cases:
Green curves: human observations
Red curves: our algorithm
- both explanations have gradient signals that are consistent with our gradient requirements
- perhaps could be fixed using monocular cues

Tsukuba and Venus:

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Ground Truth
Ours
DP with LR-check