Session 8

Machine Vision

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Stereo Vision

The word “stereo” comes from Greek word which means solid.
Vision in Animals

Independent Eyes

Frontal Eyes

Lateral Eyes

Binocular and Monocular Vision

Understanding Equine Vision

When a horse is being ridden on the bit, his vision is directed towards the ground.

Because horses have monocular vision, lighting should not be used on the saddle or by the rider. Should the horse move his head to one side their vision is immediately obstructed by the light source.
Monocular View vs Binocular View
Simple Stereo System

\[
\frac{P_l}{f} = -\frac{h + x}{z}
\]

\[
\frac{P_r}{f} = \frac{h - x}{z}
\]

\[z(P_r - P_l) = 2hf \Rightarrow z = \frac{2hf}{P_r - P_l}\]
Geometric Stereo

Stereo correspondence ambiguity

Correct

Ghost

Left image

Left centre of projection

Right image

Right centre of projection
Geometric Stereo

Occlusion

Object side invisible in right image

Object side invisible in left image

Left image

Right image

Left centre of projection

Right centre of projection
Correspondences

Match intensities sequentially between two scanlines
Correspondences

Left scanline

Right scanline

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Search Over Correspondences

Three cases:

- Sequential – cost of match
- Left occluded – cost of no match
- Right occluded – cost of no match
Standard 3-move Dynamic Programming for Stereo

Dynamic programming yields the optimal path through grid. This is the best set of matches that satisfy the ordering constraint.
Stereo Vision Application

- UGV (Unmanned Ground Vehicle)
  - Collision Avoidance
  - Safety (Auto Brake in Vehicles)
- UAV (Unmanned Areal Vehicle)
  - Monitoring
- Robotic
  - Quality Control
  - Packaging
Implementation on Embedded System

DSP Based Stereo Vision

FPGA Based Stereo Vision
Thank you for your attention