

Omni Stereo

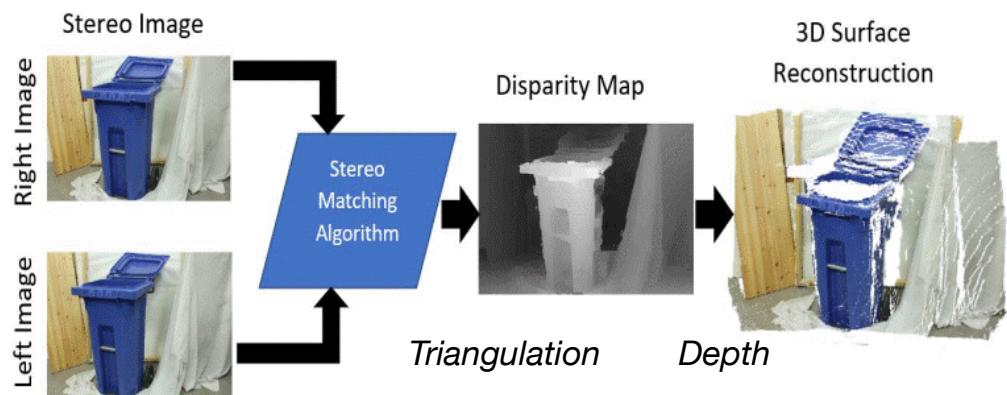
Luiz Velho
IMPA

Outlook

- Two-View Geometry
- Disparity & Depth
- Stereo for What?
- Omni Stereo
- VR Stereo Panoramas

Stereo Framework

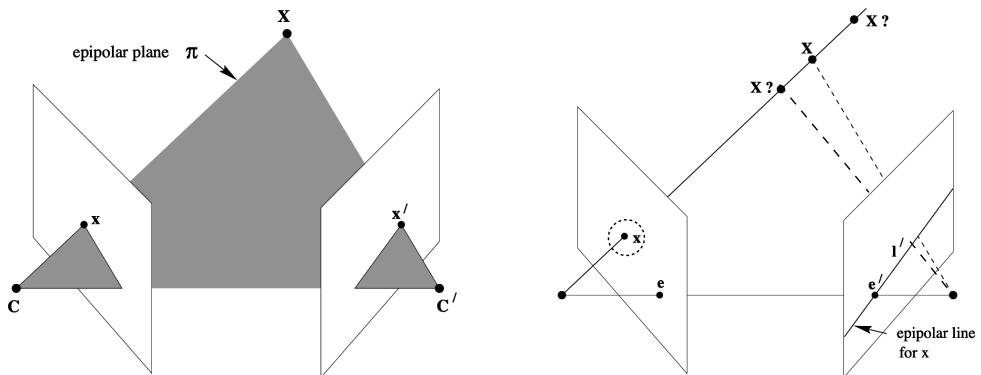
- Processing Pipeline



Two-View Geometry

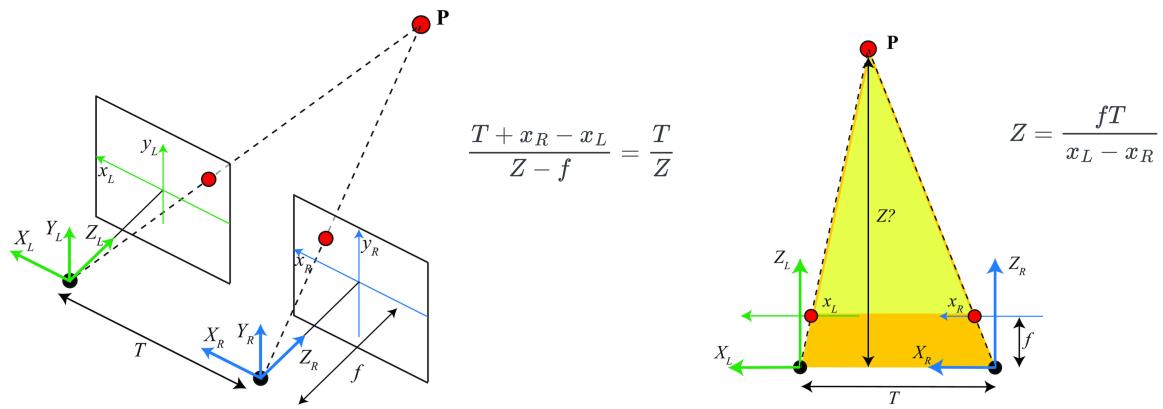
Projective Geometry for Stereo

- Epipolar Constraint



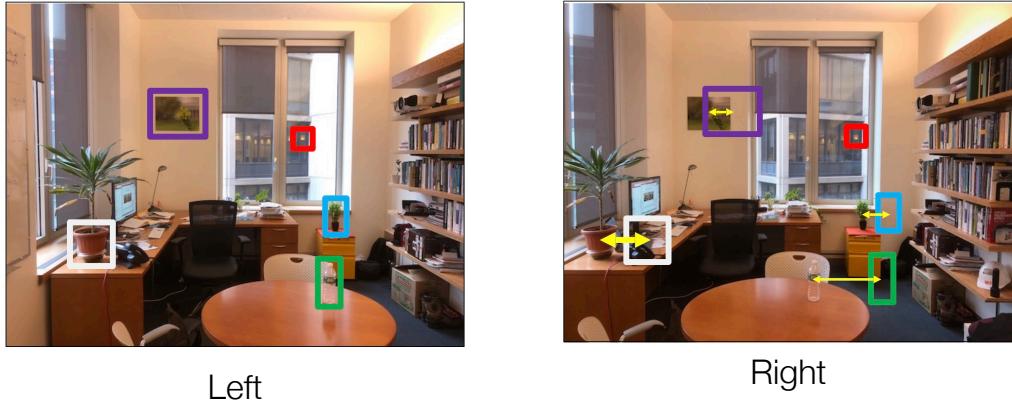
Triangulation

- Calibrated Cameras



Stereo Image Features

- Correspondences

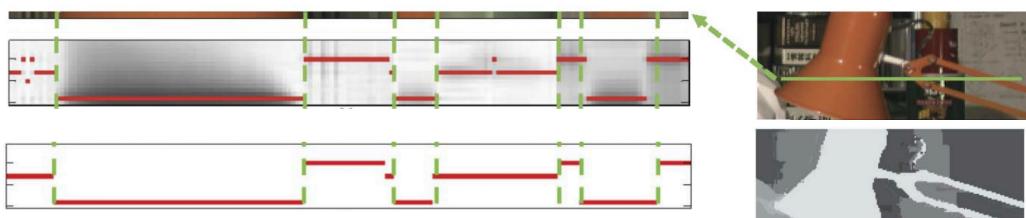


Left

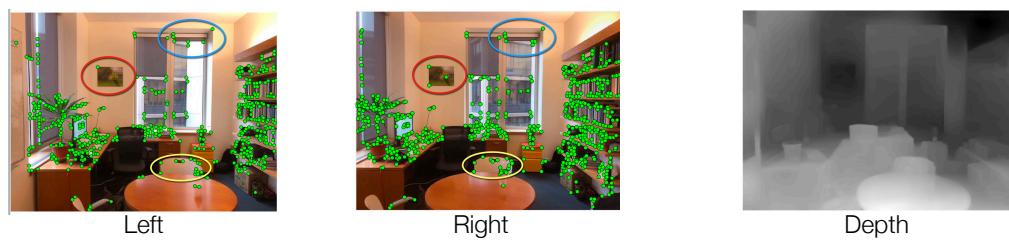
Right

Feature Matching

- Dense (line)



- Sparse (point descriptors)



Left

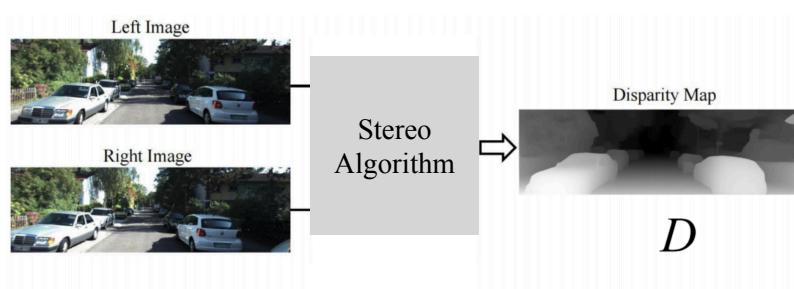
Right

Depth

Disparity & Depth

From Images to Geometry

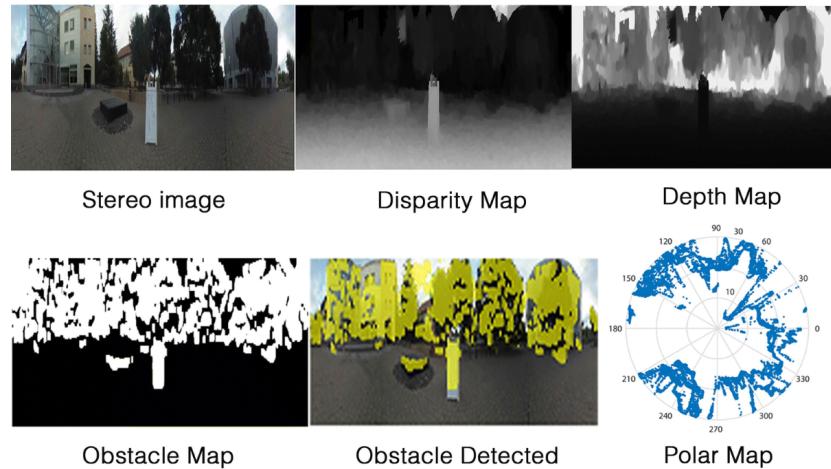
- Disparity is the Reciprocal of Depth



$$Z = \frac{B \times f}{D}$$

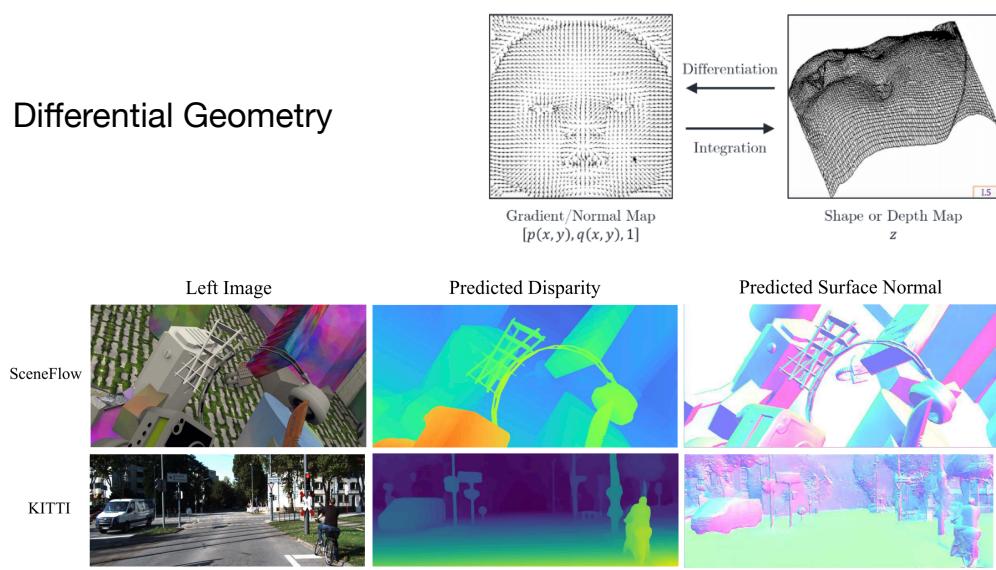
3D Reconstruction

- Scene Structure



Shape Properties

- Differential Geometry



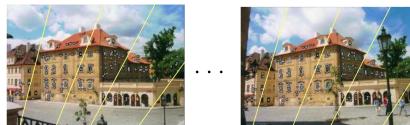
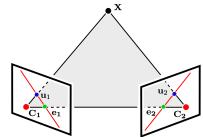
Stereo for What

Applications

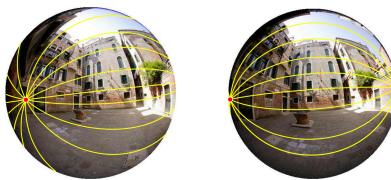
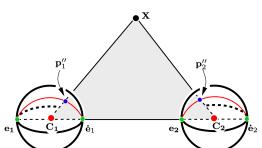
- Modeling (*Geometry*)
 - Calibration / Reconstruction
- Rendering (*Perception*)
 - Virtual / Augmented Reality
- Robotics
 - SLAM

Stereo on Steroids

- Perspective Stereo



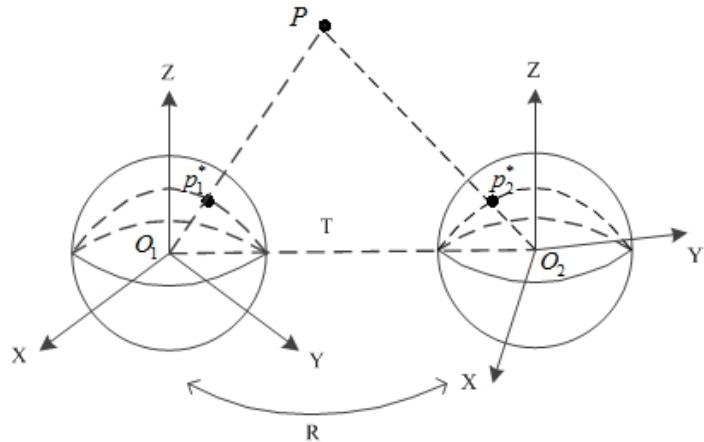
- Omnidirectional Stereo



Omni Stereo

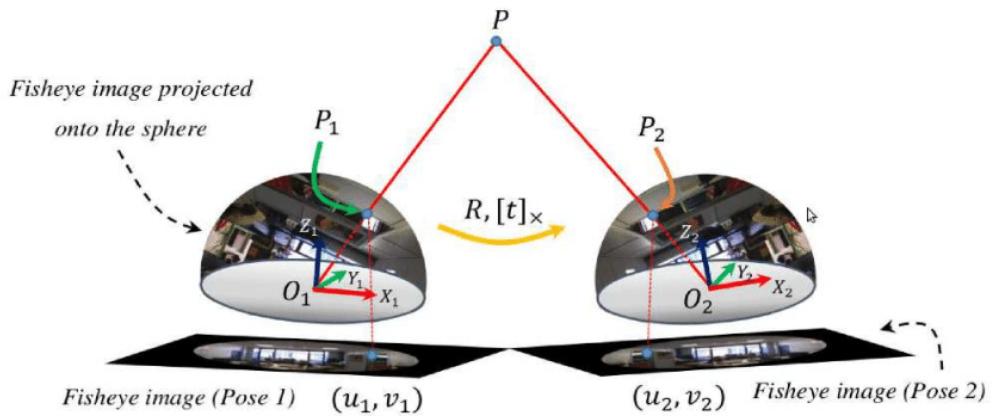
Omnidirectional Two-View Geometry

- Epipolar Constraint



Omnidirectional Stereo Imaging

- Models and Representation



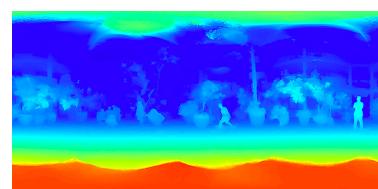
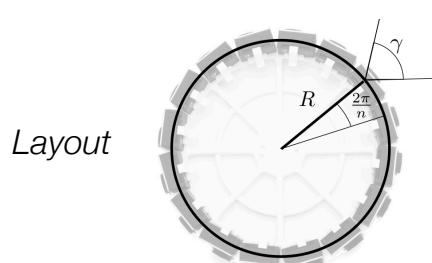
360 End-2-End

- Capturing and Viewing a Panorama



Omni Stereo Capturing

- Stereo Omnidirectional Rigs

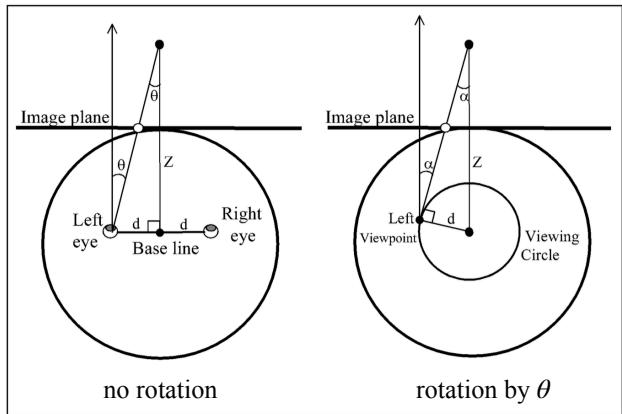
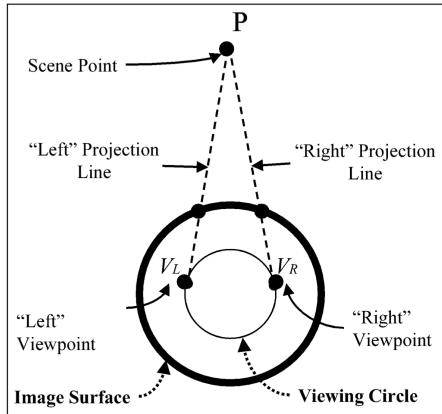


Images

Depth

Omni Stereo Viewing

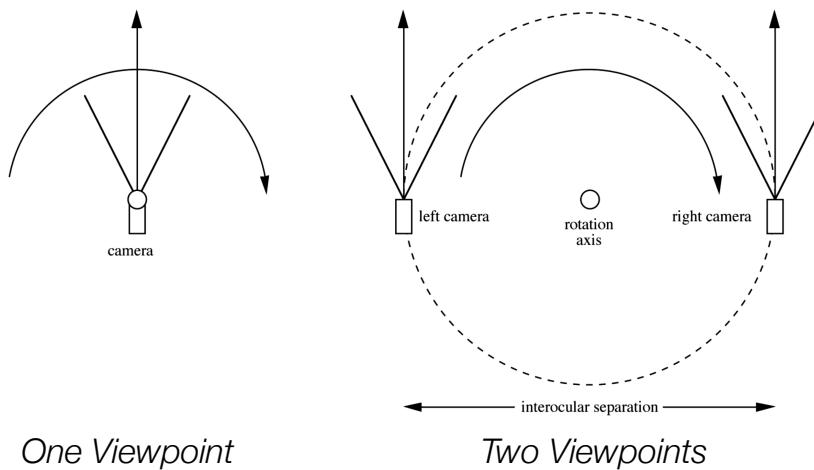
- Two Eyes - Head Rotates



VR Stereo Panoramas

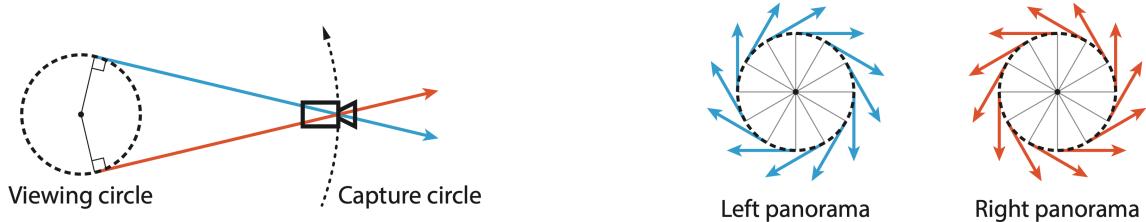
The Stereoscopic Difference

- 360 Panorama vs. 360 Stereo



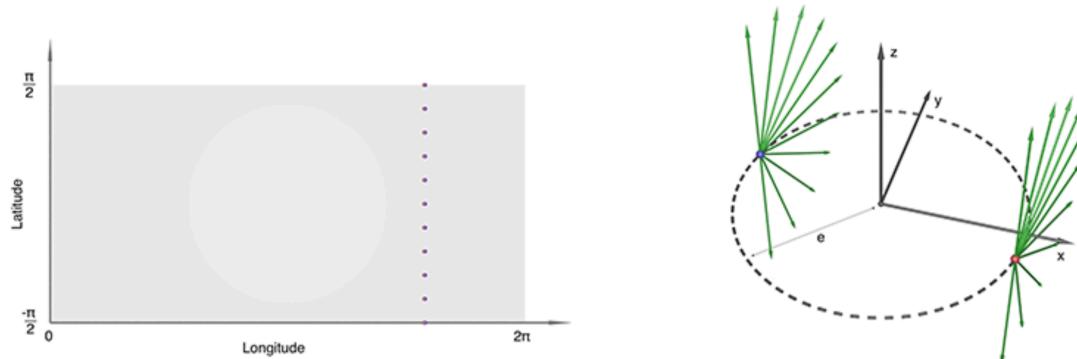
How to Build a Stereo Pair?

- Viewpoint is on the Viewing Circle



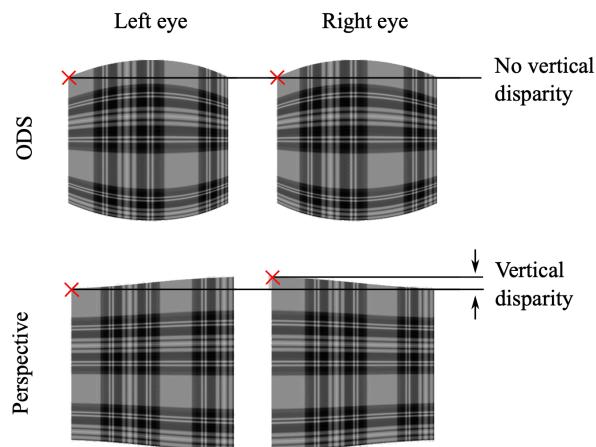
360 Panorama Representation

- View Direction Dependent



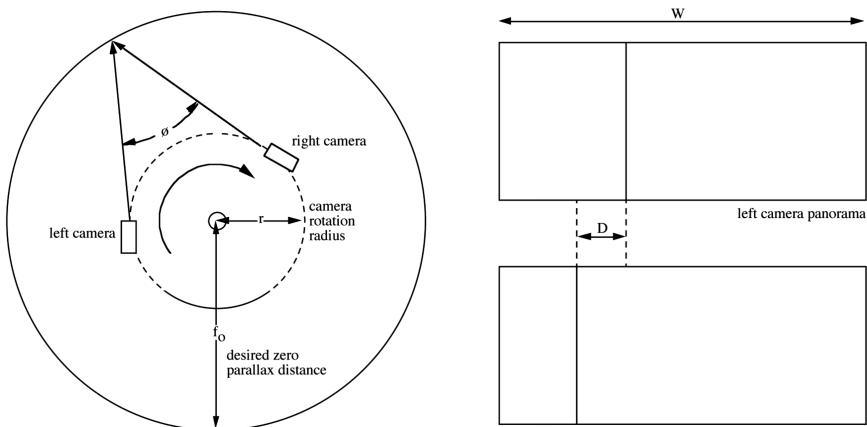
What about Disparity?

- Circular Rig Layout => Horizontal Disparity



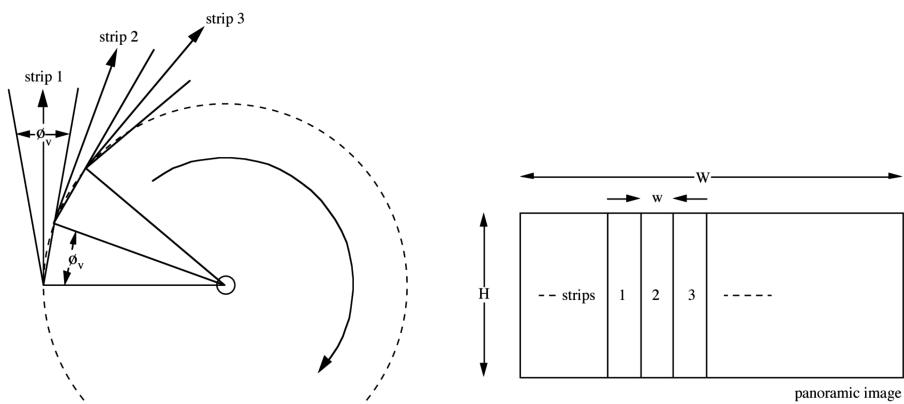
View Directional Stereo

- Disparity is Dependent on View Angle



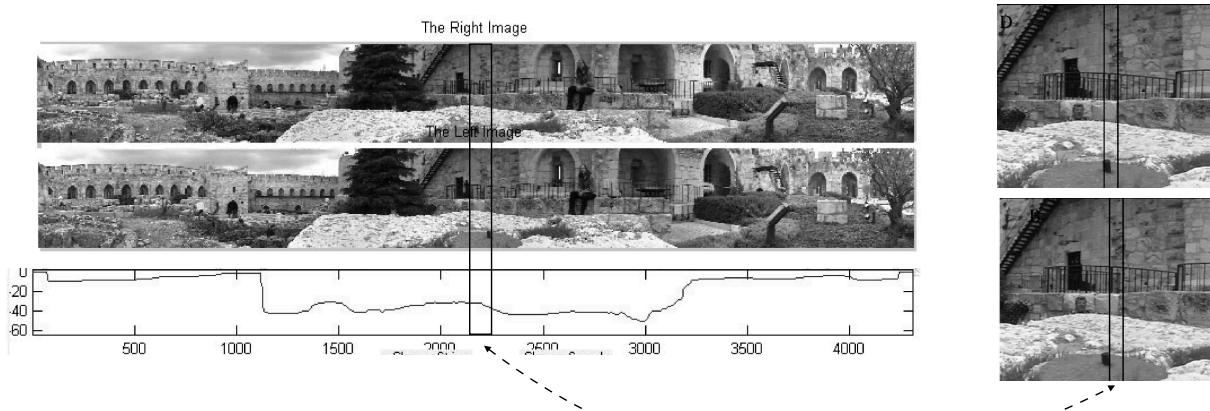
Disparity Strips

- Angle-Dependent Window



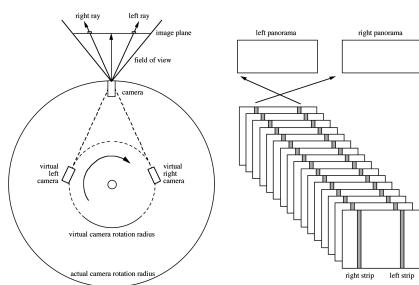
Omni Stereo Left-Right Pair

- Stereo Strip Window

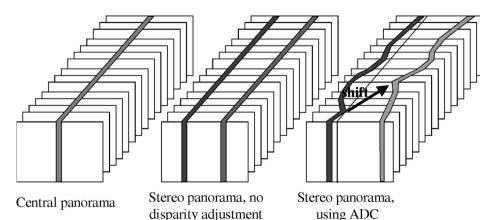


Disparity Adjustment

- Adjusting Strip Separation



Reference Scheme



Automatic Disparity Control

Omnidirectional Stereo Process

- Production Pipeline

