

# Omni Stereo

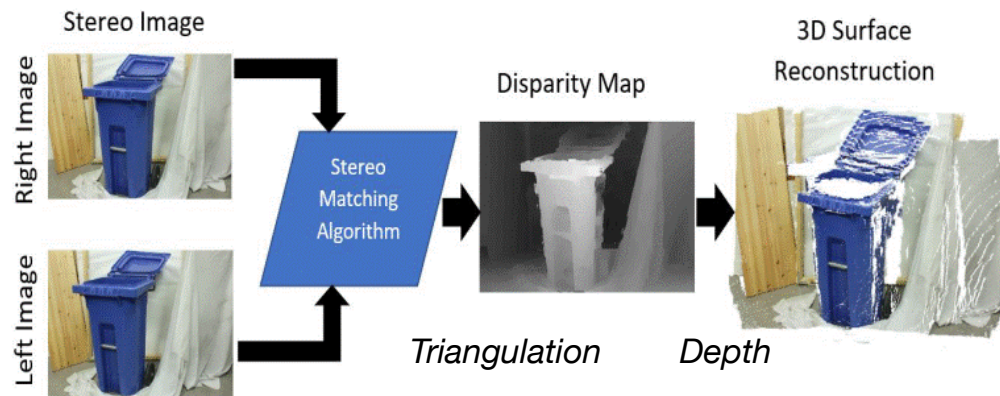
Luiz Velho  
IMPA

## Outlook

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

# Stereo Framework

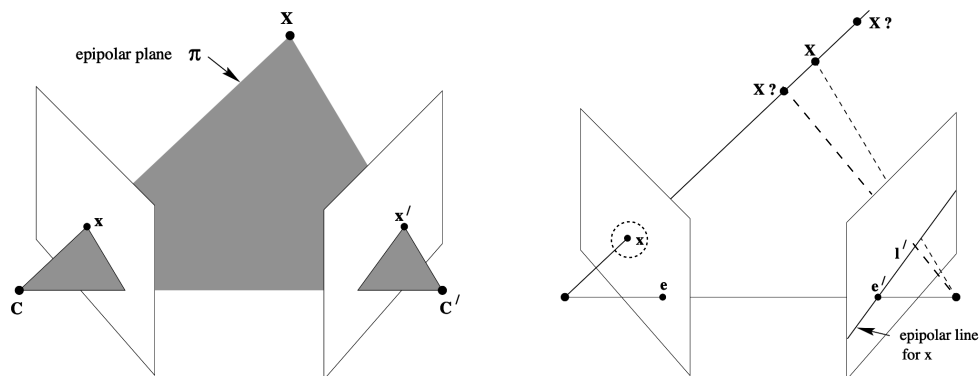
- Processing Pipeline



*Two-View Geometry*

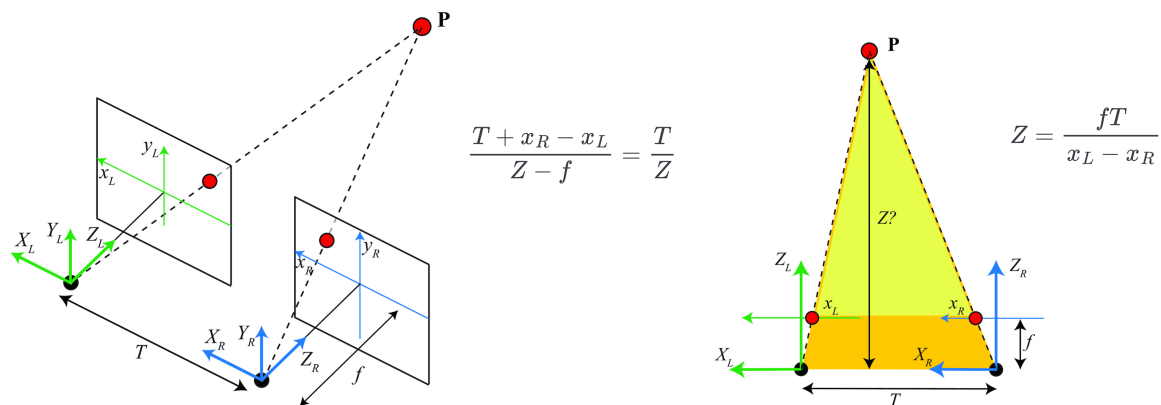
# Projective Geometry for Stereo

- Epipolar Constraint



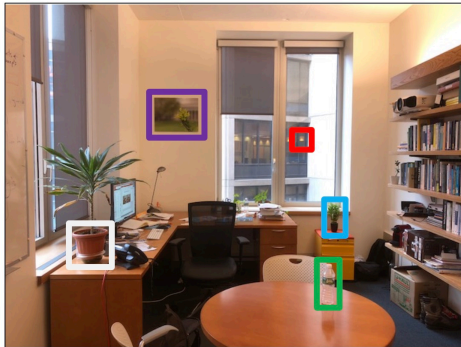
# Triangulation

- Calibrated Cameras

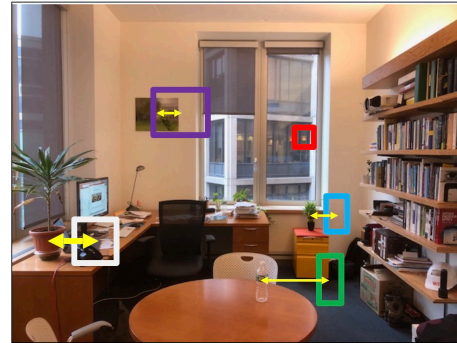


# Stereo Image Features

- Correspondences



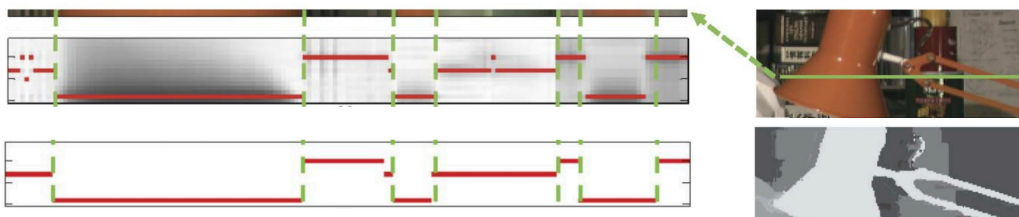
Left



Right

# Feature Matching

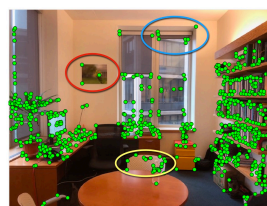
- Dense (line)



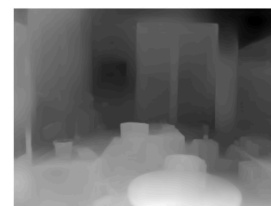
- Sparse (point descriptors)



Left



Right



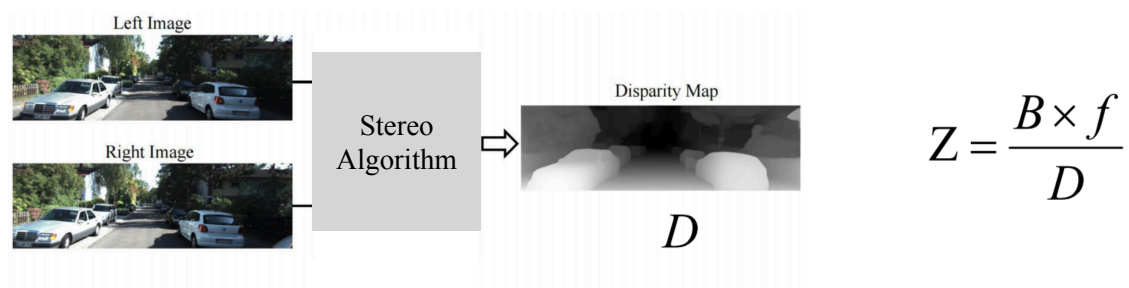
Depth



# *Disparity & Depth*

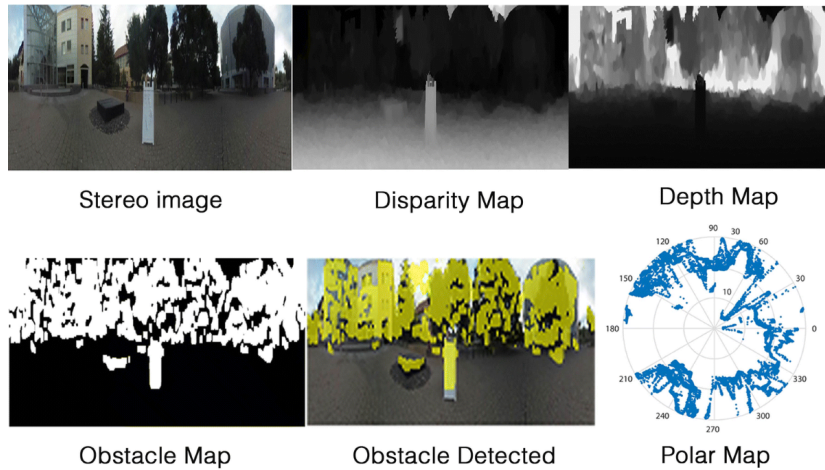
## From Images to Geometry

- Disparity is the *Reciprocal* of Depth



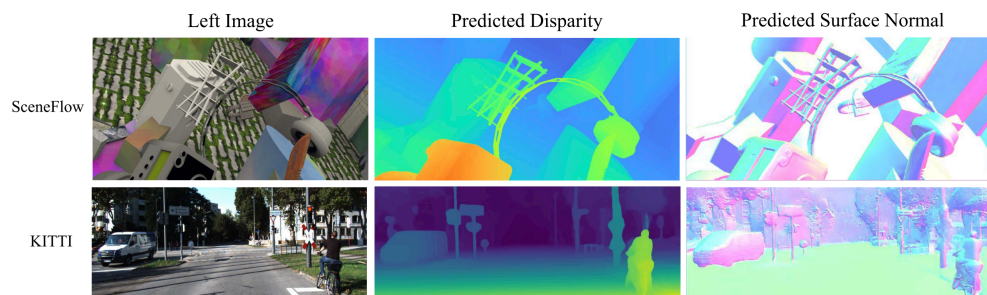
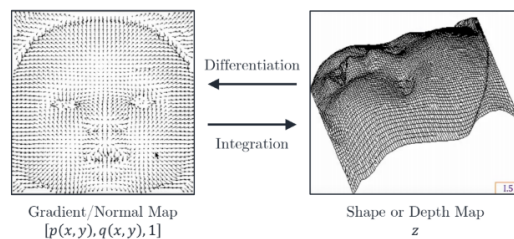
# 3D Reconstruction

- Scene Structure



# Shape Properties

- Differential Geometry



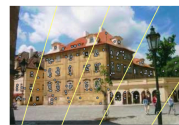
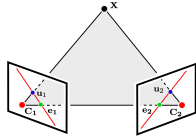
# *Stereo for What*

## **Applications**

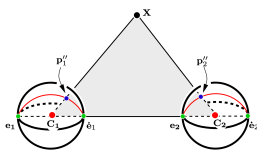
- Modeling (*Geometry*)
  - Calibration / Reconstruction
- Rendering (*Perception*)
  - Virtual / Augmented Reality
- Robotics
  - SLAM

# Stereo on Steroids

- Perspective Stereo



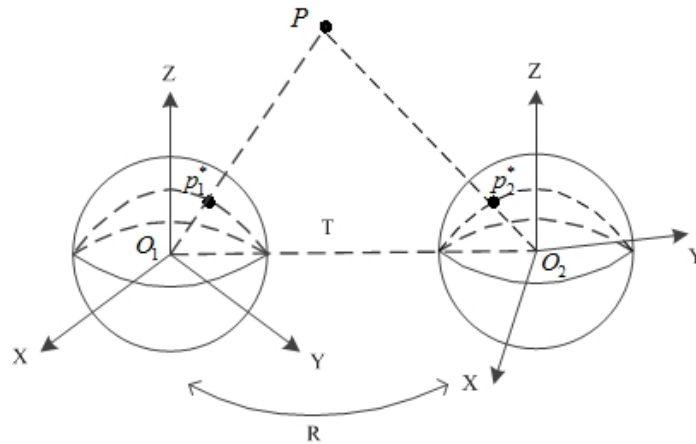
- Omnidirectional Stereo



*Omni Stereo*

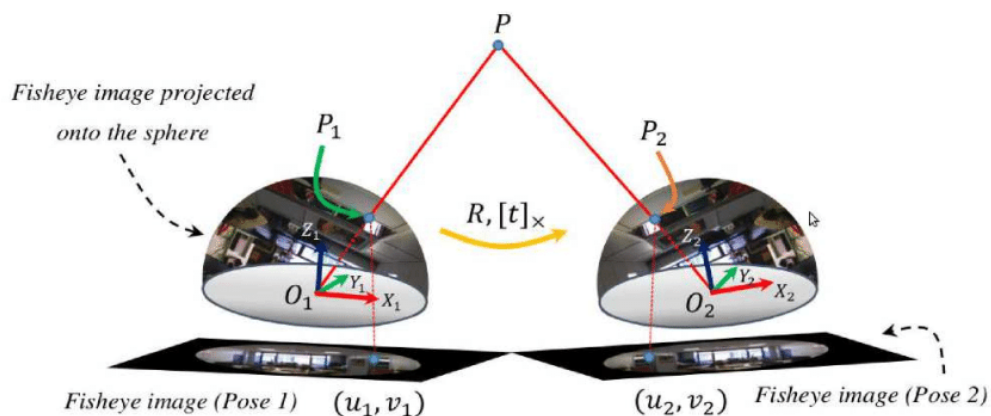
# Omnidirectional Two-View Geometry

- Epipolar Constraint



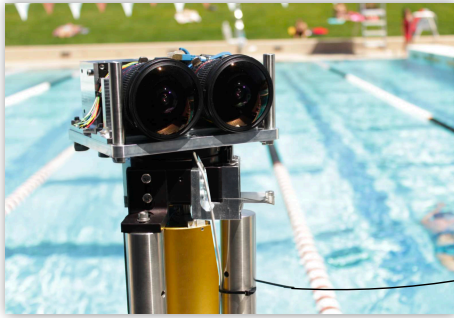
# Omnidirectional Stereo Imaging

- Models and Representation



# 360 End-2-End

- Capturing and Viewing a Panorama



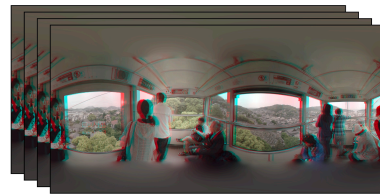
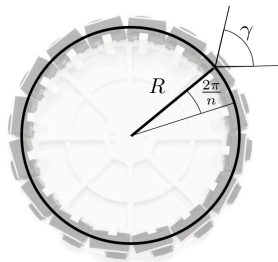
# Omni Stereo Capturing

- Stereo Omnidirectional Rigs

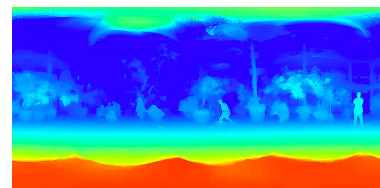
*Cameras*



*Layout*



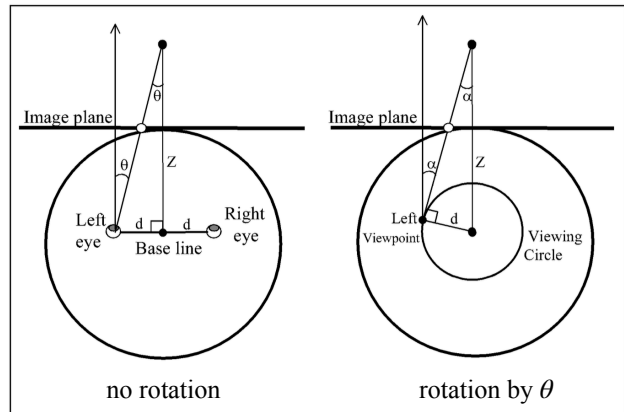
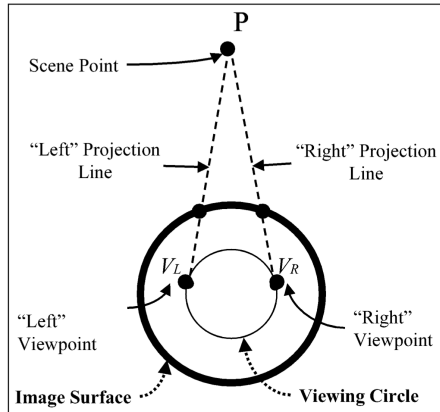
*Images*



*Depth*

# Omni Stereo Viewing

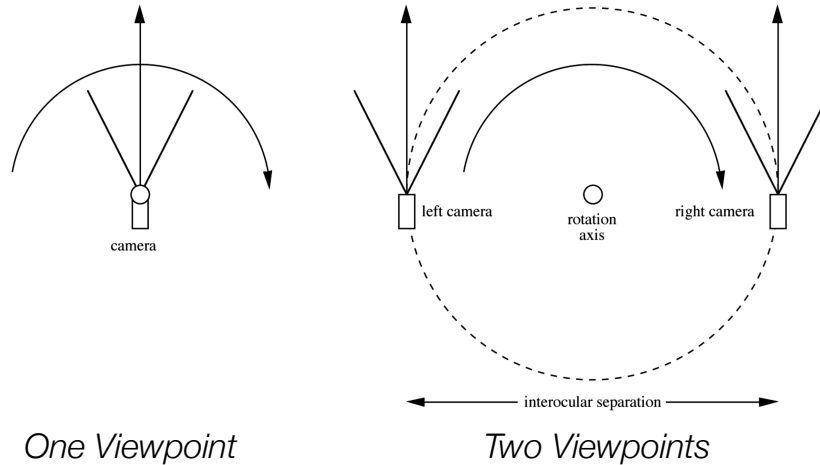
- Two Eyes - Head Rotates



*VR Stereo Panoramas*

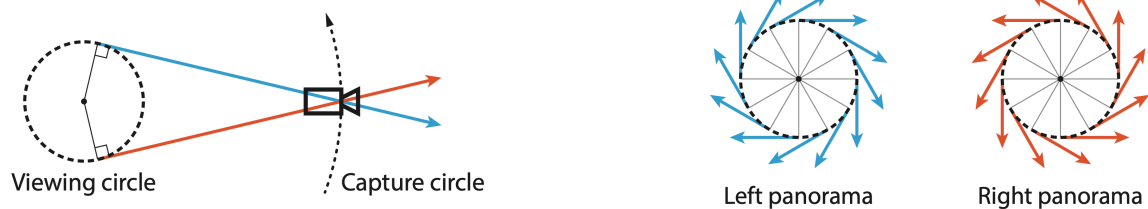
# The Stereoscopic Difference

- 360 Panorama vs. 360 Stereo



## How to Build a Stereo Pair?

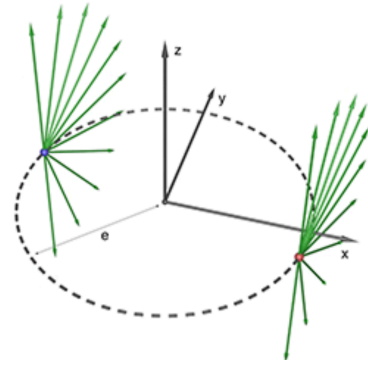
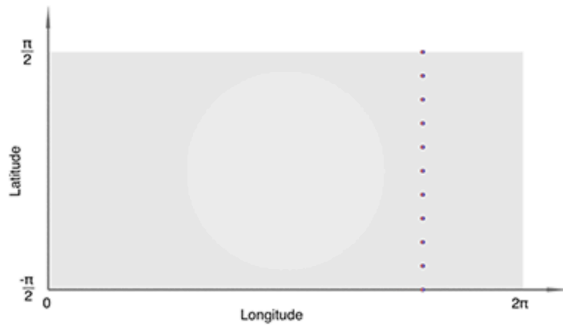
- Viewpoint is on the Viewing Circle





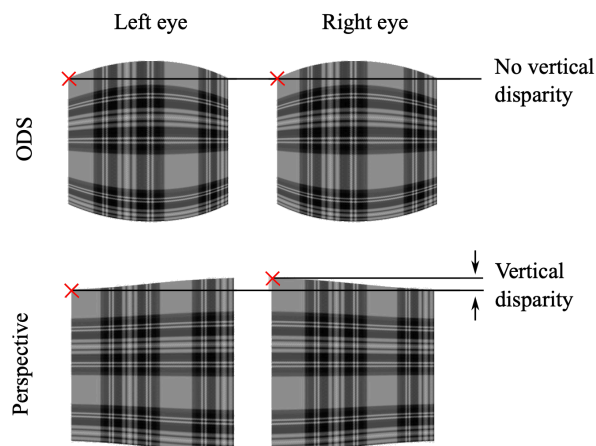
# 360 Panorama Representation

- View Direction Dependent



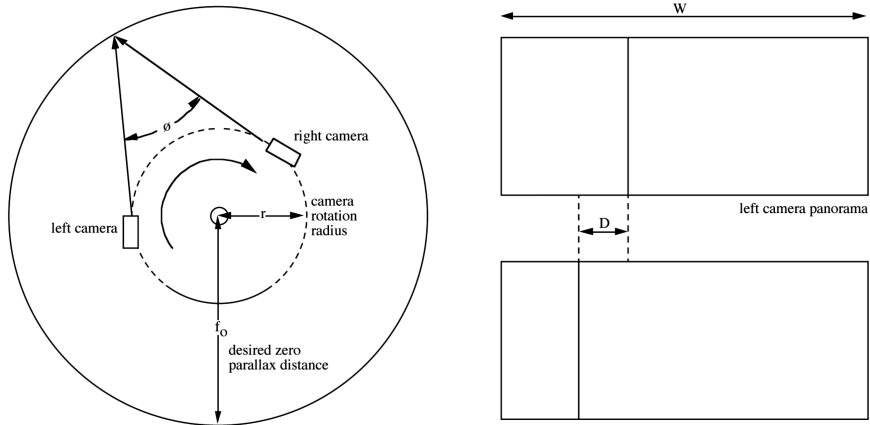
## What about Disparity?

- Circular Rig Layout => Horizontal Disparity



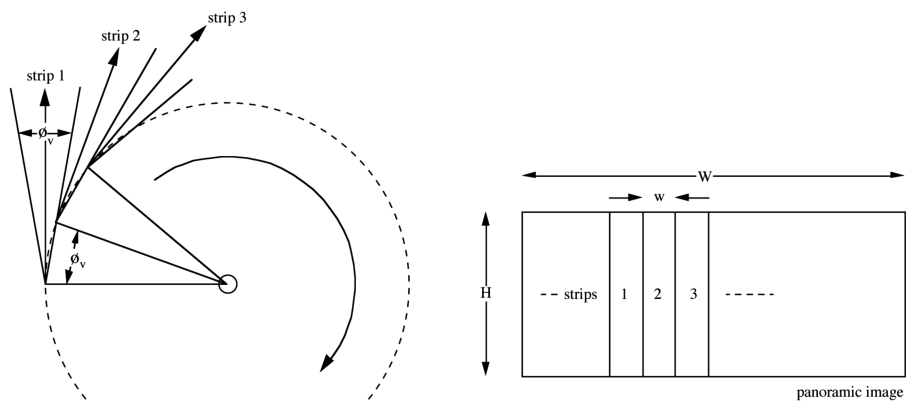
# View Directional Stereo

- Disparity is Dependent on View Angle



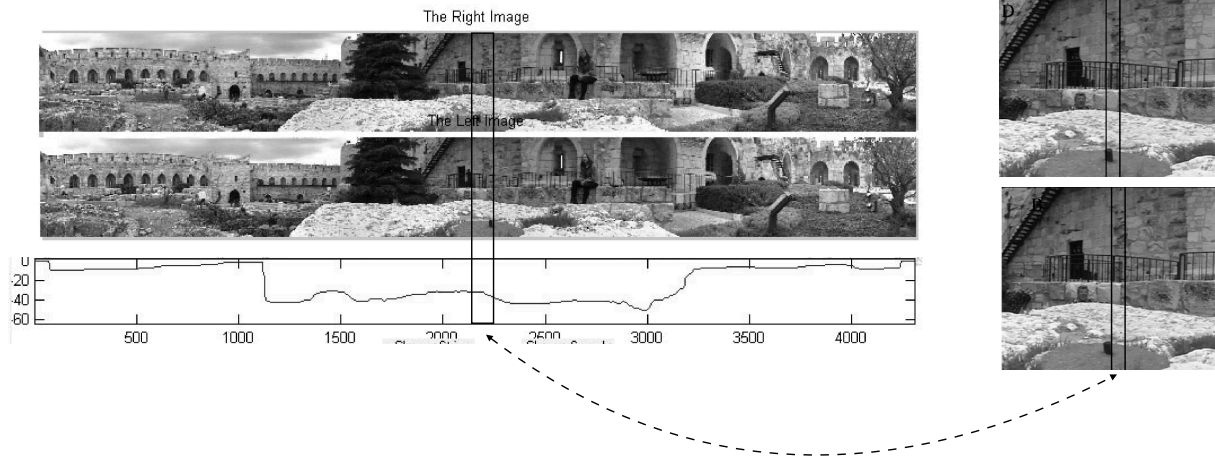
# Disparity Strips

- Angle-Dependent Window



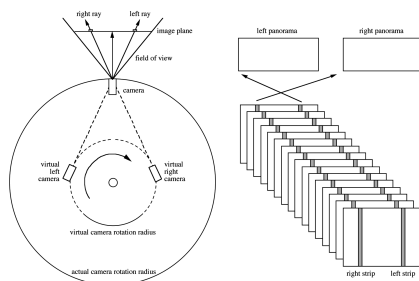
# Omni Stereo Left-Right Pair

- Stereo Strip Window

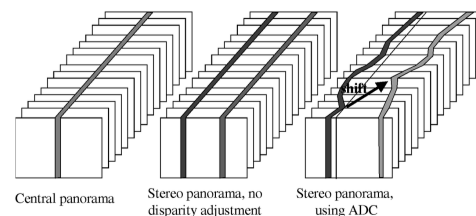


# Disparity Adjustment

- Adjusting Strip Separation



*Reference Scheme*



*Automatic Disparity Control*

# Omnidirectional Stereo Process

- Production Pipeline

