Synthetic Stereoscopic Panoramic Images

What are they?
How are they created?
What are they good for?

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Introduction & Motivation

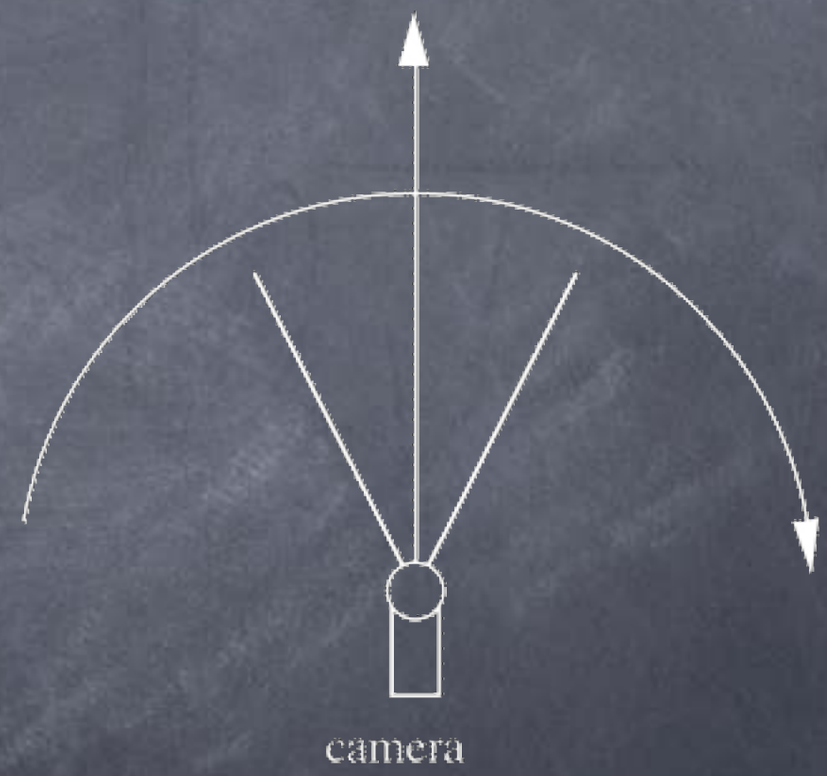
- Familiar with QuickTime VR and many derivatives.
- Cylindrical panoramic projections.
- Applications in virtual environments and interactive cinema.
- Suited also to data visualisation where realtime graphics isn't possible and/or the desired render quality is high.
- Stereoscopic panoramic images support the two features of the human visual system not normally present in computer displays: peripheral vision and stereopsis.

Camera model: monoscopic panoramic

- Single rotating slit camera

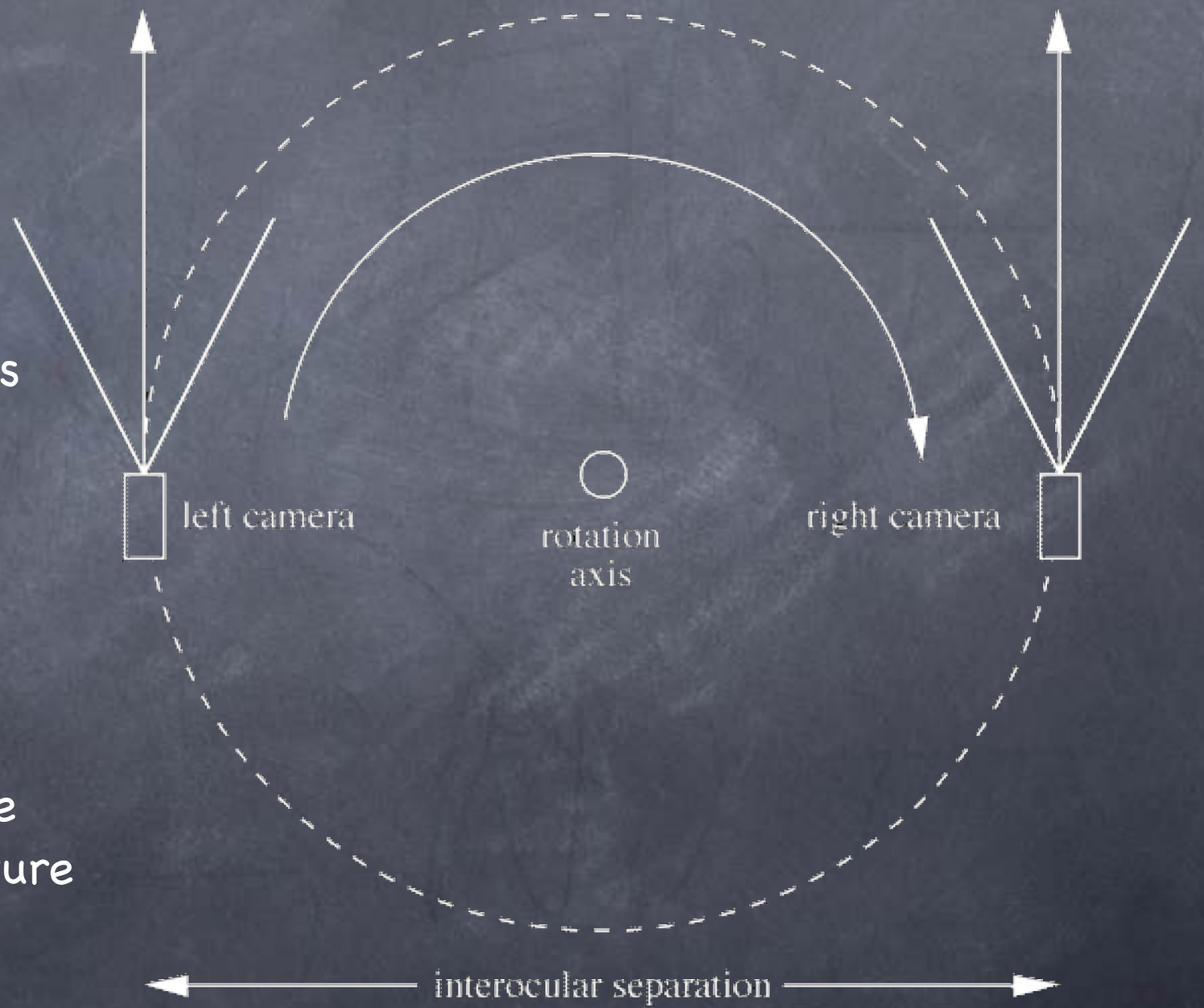
- Approximations using stitching work OK for monoscopic images but not stereoscopic.

- Rotating two cameras independently about their centers obviously doesn't give a stereoscopic panoramic pair.



Camera model: stereoscopic panoramic pair

- Twin rotating slit camera. Copes with movement in the scene.
- Usually possible to script most rendering packages to achieve this.
- Real cameras exist, for example the Roundshot, continuous capture onto 70mm film.



Example: Hampi (India)

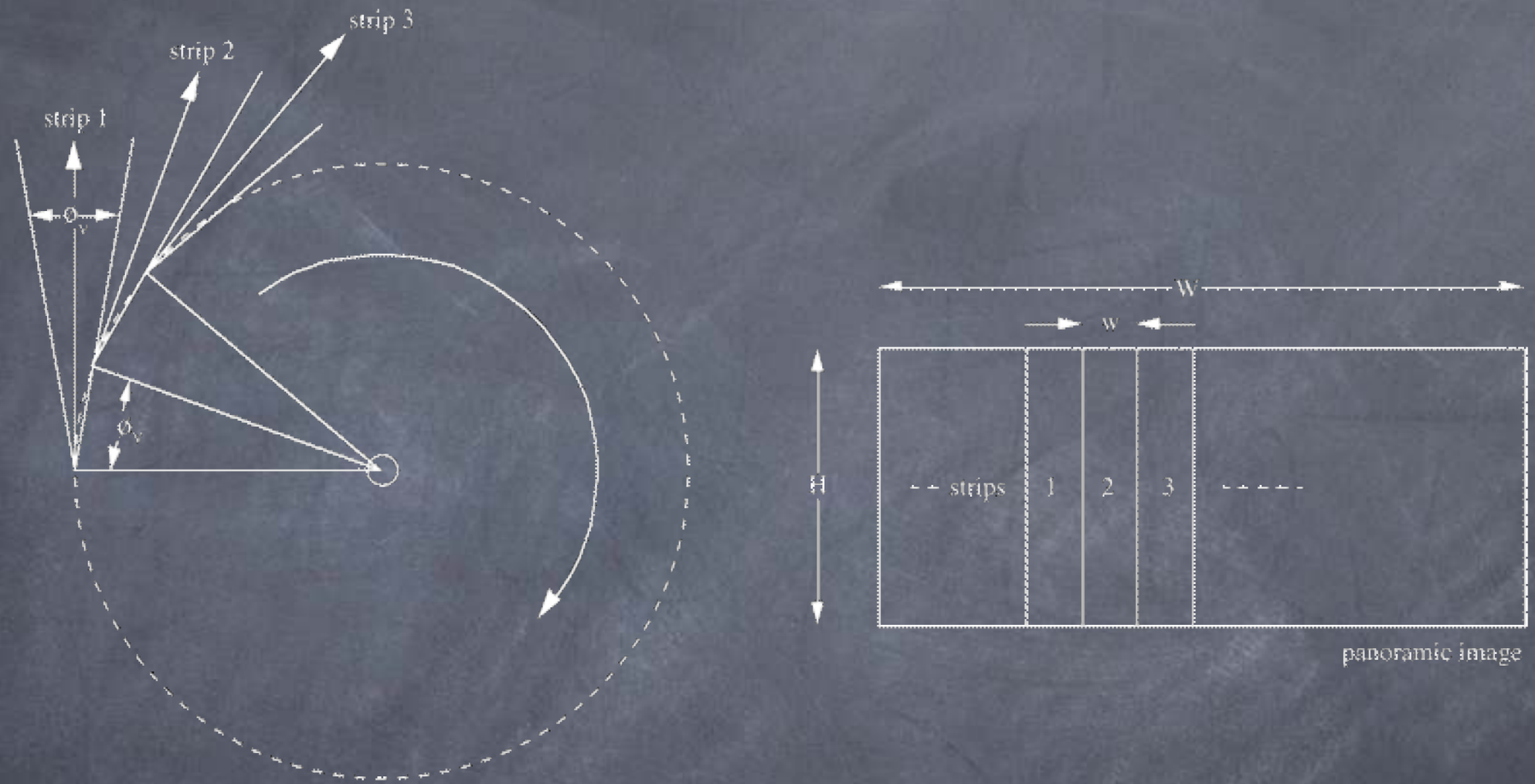
Left eye

Right eye

PLACE-Hampi: Sarah Kenderdine, Jeffrey Shaw & John Gollings
Icinema, UNSW

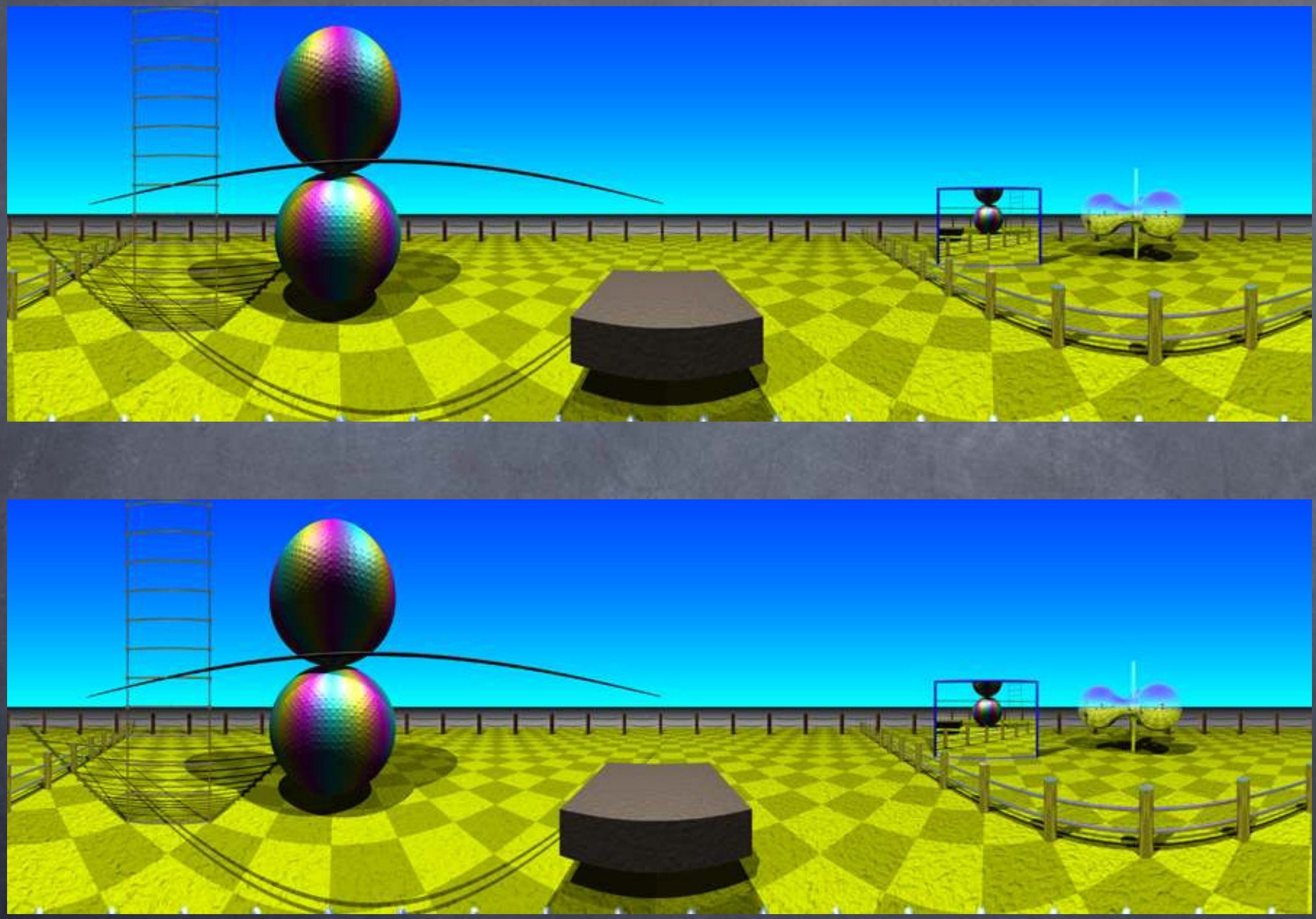
- Roundshot VR camera.
- 10,000+ pixels across, drum scanned.
- Between 1000 to 4000 pixels high depending on the lens.
- Requires alignment and edge blending post processing.

CG: Slit rendering



- Combine many narrow perspective projections: eg: 1 degree horizontally by 90 degrees vertically.
- Camera rotates in steps of the horizontal aperture for a perfect stitch.

Test image



Left eye

Right eye

POVRay

Example: Royal Exhibition Building

Left eye

Right eye

3D StudioMax

Suzanne Bekhit, Amanda Kuek, Handa Lie

Stereoscopic matching: Film & CG

- Combining photographic & synthetic (compositing), more difficult for stereoscopic content. In traditional compositing, even of 3D content, there is less depth perception.
- Matching field of view vertically, determines aspect of panorama image.
- Determine strip width (w) in pixels, determines panoramic width (W).
- Horizontal aperture needs to be an integer divisor of 360 degrees.
- Match the eye/camera separation, not necessarily the human eye separation.
- Lens correction of film or lens warping of CG?
  Lens distortion is only in the vertical direction.
- Matching/setting the distance to zero parallax.

$$w = W \, \phi_h / 360$$

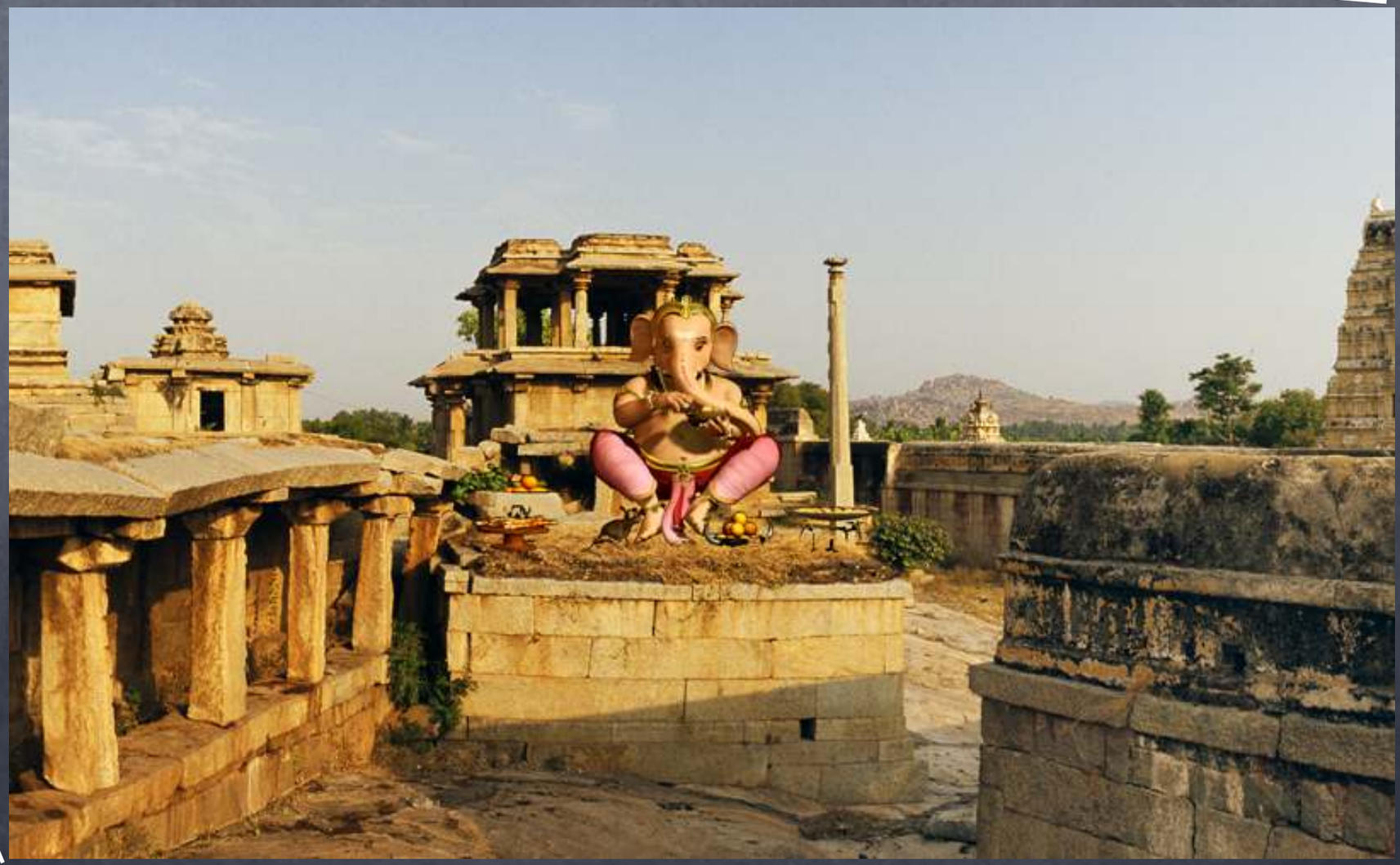
$$\phi_v = 2 \, \mathrm{atan}(H \, \pi / W)$$

$$H \tan(\phi_h / 2) = w \tan(\phi_v / 2)$$

Precise matching of parallax

Ganesha

LightWave



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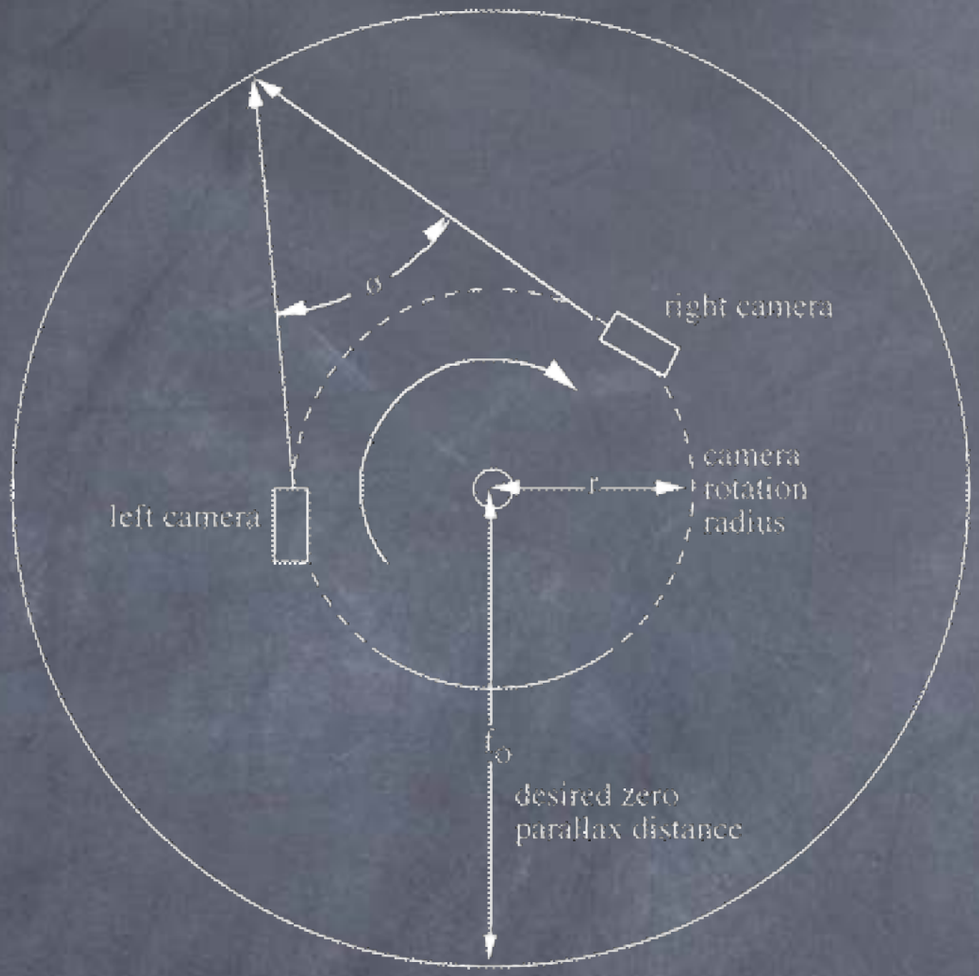
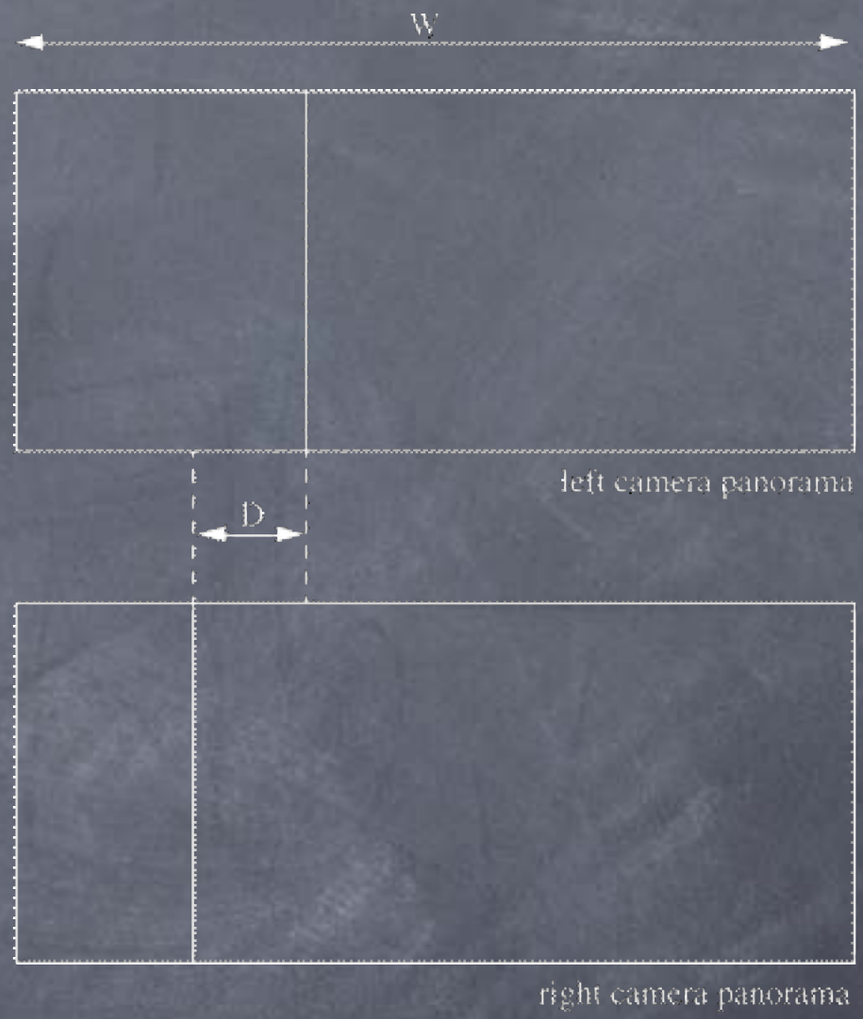
Choosing distance to zero parallax





- Zero parallax can be set in post production or preferably in the playback software by sliding images horizontally with respect to each other, wrapping at the left/right boundary.

- No magic, given the characteristics of the cameras we can determine shift by D pixels to give a particular zero parallax distance f_o.

$$D = W \, ø \, / \, (2\pi) = W \, \mathrm{asin}(r \, / \, f_o) \, / \, \pi$$

Example

9216 x 1024 pixels

LightWave

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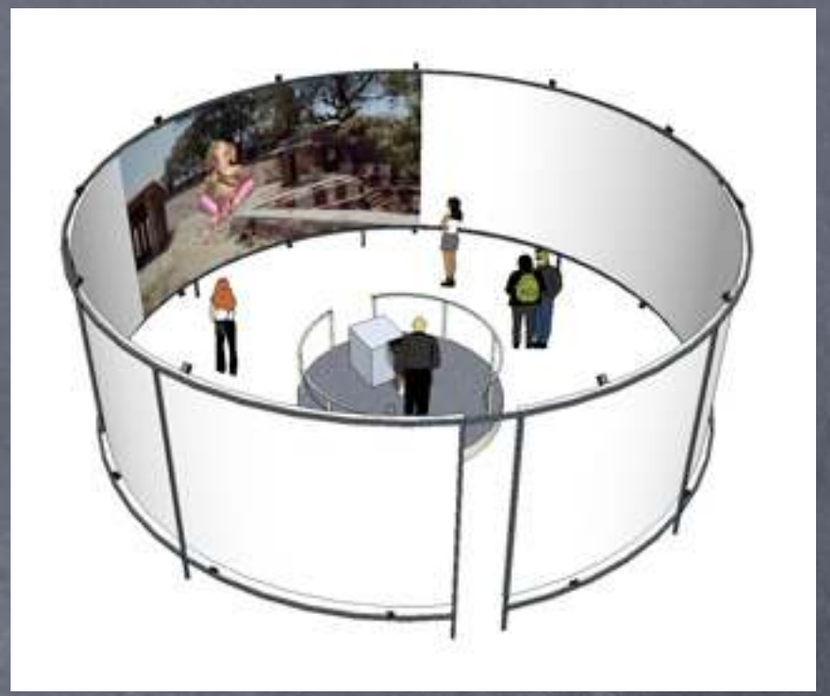
Projection Environments

- Flat display screen(s) or wall(s).
- While movie is running you can zoom/rotate.
- Full cylindrical environments, AVIE (ICinema).
- Geometry correction and edgeblending of 6 pairs of SXGA+ projectors (1400x1050), 12 projectors in total.
- Stereoscopic dome.
- Ideal strategy would be to keep all stereoscopic pairs with zero parallax at infinity (parallel cameras) and apply desired zero parallax within the playback software.



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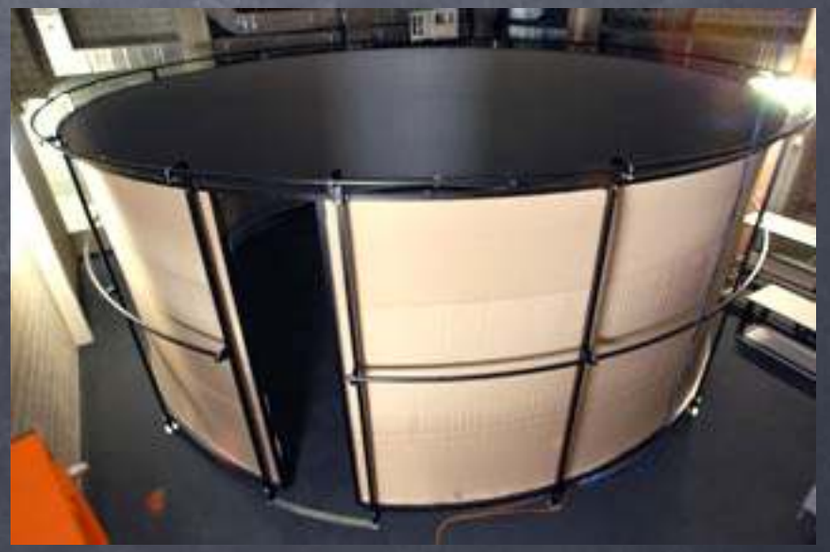

Summary

- Succeeded in creating comfortable viewing stereoscopic panoramic pairs.
- Developed techniques to create synthetic panoramic and composite with photographic panoramic pairs with correct and matching depth relationships.
- Technique applies equally to rendered (raytraced) content as well as interactive (OpenGL) content using multipass texture approach.
- Developed software that presents stereoscopic panoramic images on flat screen or in a full cylinder (later requires geometry correction and edge blending).
- Has been extended to display stereoscopic panoramic movies (ICinema, UNSW).

Questions?