Visualisation @ WASP

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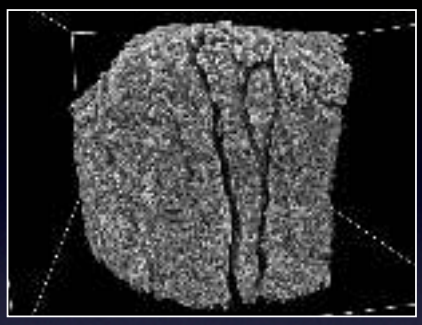
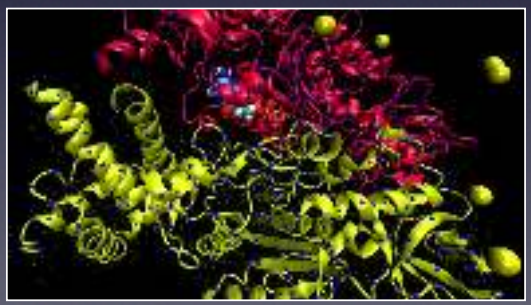
- Summary of the visualisation resources at the WASP.
  - Visual displays.
  - Image/video capture.
  - Novel hardcopy printing.
- Small selection of projects from 2008.
  - Stereoscopic filming.
  - Immersive volumetric rendering.
  - Holograms.
  - Gaming engines.
  - Ladybug filming.



Geology - Volume rendering volcanic rock

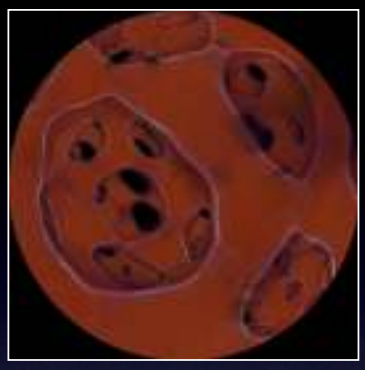
Astronomy - 6dF Galaxy survey



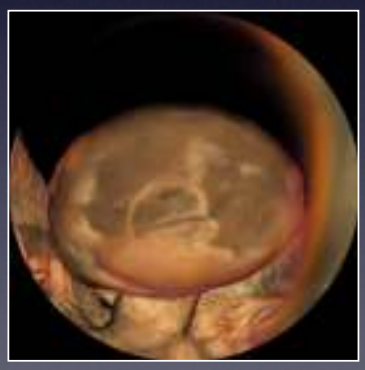
Molecular - F1 molecular motors

Summary of resources

- Stereoscopic projection, fixed and portable.
- Immersive dome environment.
- High resolution tiled display (coming soon).
- High definition SLR camera and fisheye lens.
- Ladybug-2: 360x150 degree video.
- Stereoscopic video cameras.
- Miscellaneous:
  - Workstations.
  - Professional grade graphics cards.
  - Projectors.
- Holograms, crystal engraving, rapid prototyping.
- Expertise.



Reticulite



Fossil whale cochlear

WASP, rear projection

Learning Teaching Technologies

Stereoscopic displays

WASP, portable system

Discovery Centre, Geology

Animation (ASKAP model)

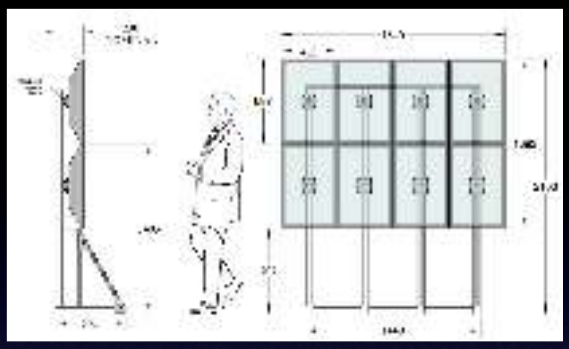
Virtual reality (Mawsons hut, Peter Morse)

iDome

360 degree filming (Rio Tinto)

Volume rendering (Liver CT, Tim Senden)

Tiled display



- Each panel 2560 x 1600 pixels.
- Total will be 6400 x 5120 pixels.
- Coming soon ....

Stereoscopic filming

Fisheye filming

Image/Video capture

Fisheye stills

LadyBug 360 video camera

Rapid prototyping (Fossil fish vertebrae)

Crystal engraving (Human heart)

3D printing

Synthetic holograms (Fossil fish jaw)

Glasses free 3D viewing with parallax

Selection of Projects

- Human movement PhD project.
  - Scale accurate stereoscopic filming and playback.
- Fulldome visualisation of volumetric data.
  - iDome.
  - Horizon The Planetarium.
- Synthetic Holograms.
- Leveraging the software investment being made in the gaming industry.
  - SecondLife.
  - Unity.
- Ladybug filming.
  - Wollongong.
  - Karratha.

Reconstruction of structure from photographs

Biological scans - fish eyeball

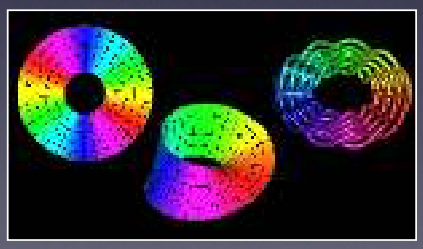
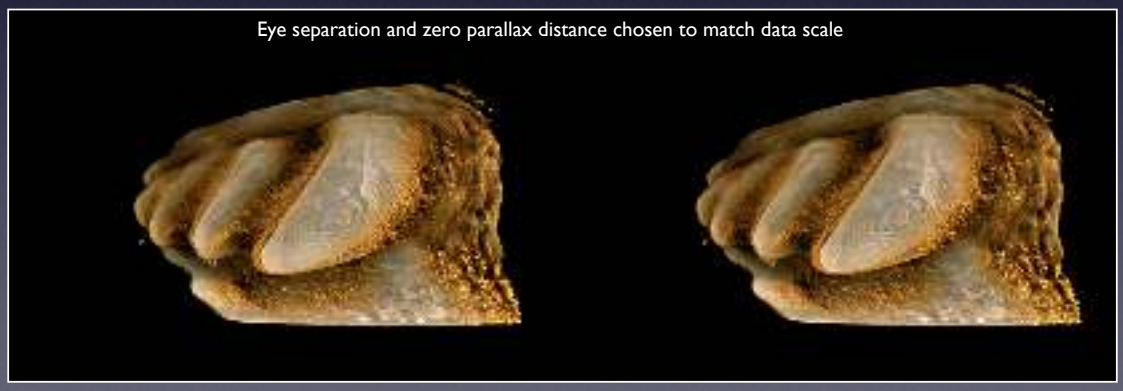


Illustration of mathematics in vision research

Stereoscopic filming

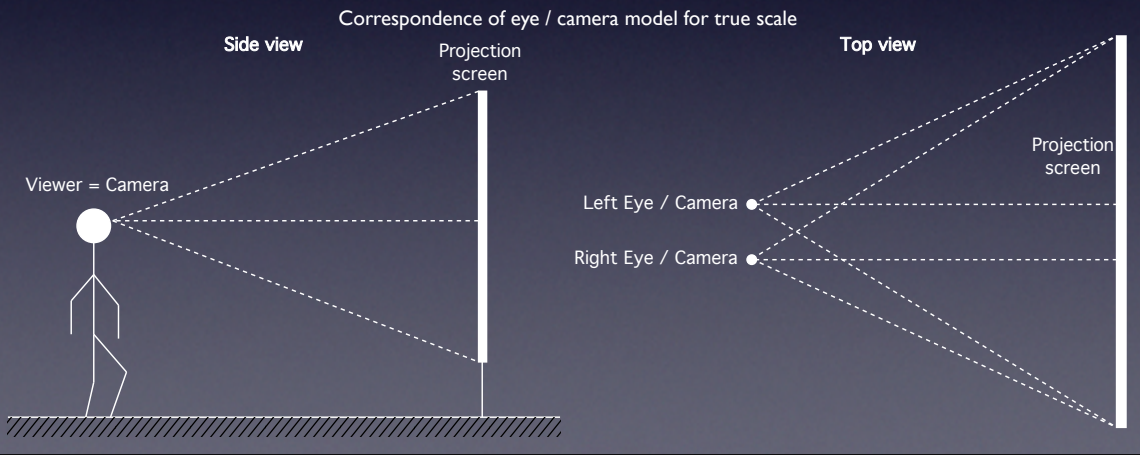
- Three-Dimensional Stereoscopic Stimulus to Examine Side-Stepping for Risk of Anterior Cruciate Ligament Injury.
  [Marcus Lee]
- Stereoscopic image generation for data visualisation often does not need to be concerned with scale.
- Indeed scale accuracy isn't always possible for objects larger or smaller than our human and/or display size, for example, microCT scans or cosmological simulations.
- Rule of thumb approach is to set the eye separation at 1/30 of the distance to zero parallax.

Eye separation and zero parallax distance chosen to match data scale



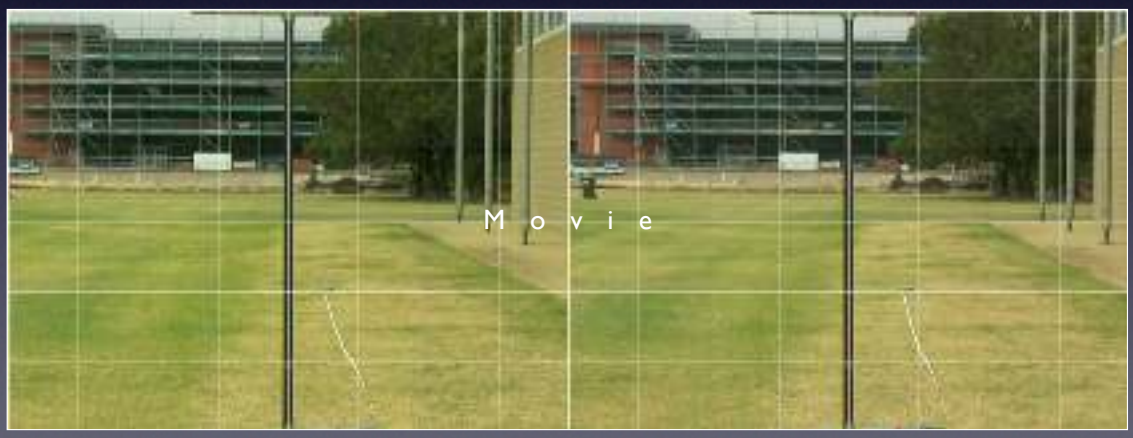
Stereoscopic filming

- For truly correct generation there is a one to one relationship between the virtual camera / projection plane and the human viewer / projection screen.
- If the field of view (eyes to the projection screen = aperture of camera) match then a true scale and depth sense can be achieved.
- Developed a protocol for filming and post-production to maximise a correct sense of scale and depth.



Stereoscopic camera rig

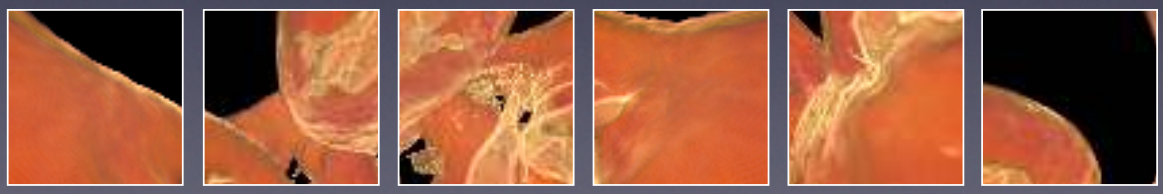
Playback in stereo3D



Calibration procedure in Final Cut Pro

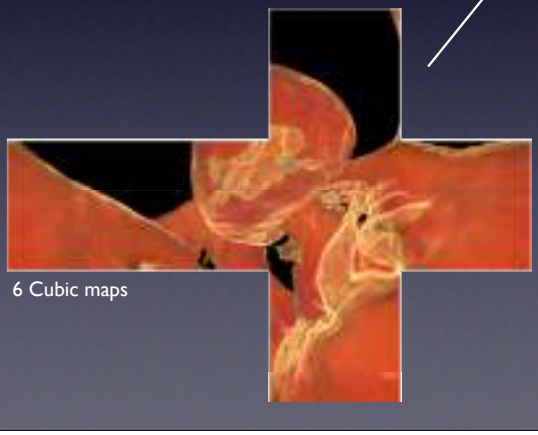
Fulldome volume visualisation

- Support added to Drishti for creating movies suitable for fulldome projection, need at least a fisheye projection.
- Strickly speaking only 4 cube face renderings are required for a fisheye, Drishti generates all 6 cube faces thus supporting full spherical projections.
- Full spherical projections allow semi-interactive exploration in the iDome.
- "Artforms of Nature" our first fulldome demonstration of volume visualisation for Horizon - The Planetarium. (Ajay Limaye, Peter Morse, Paul Bourke).
- Project for 2009 is to support realtime fulldome volume visualisation in the iDome.
- Unlike stereoscopic projection which works best when one is on the "outside", the iDome is better when one wants to be inside ... immersed in the data.

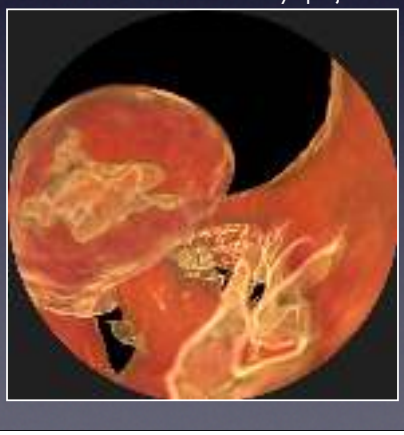


Left | Front | Right | Back | Top | Bottom

Spherical projection

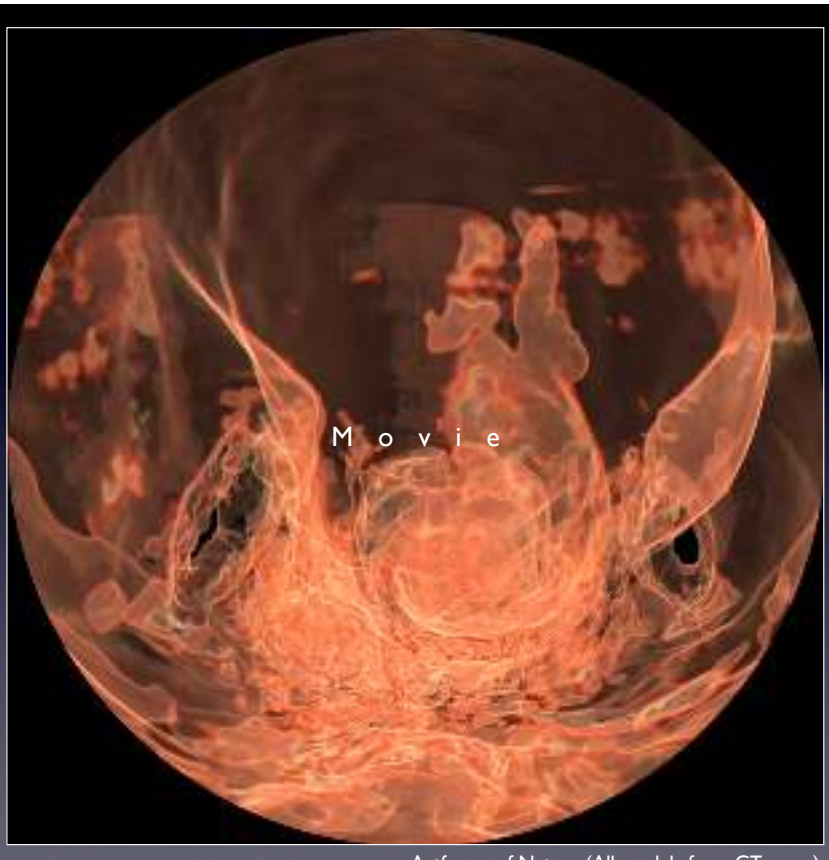


6 Cubic maps



Interactive fisheye projection

Volume visualisation in the iDome



Artforms of Nature (All models from CT scans)

Synthetic holograms (Lumograms)

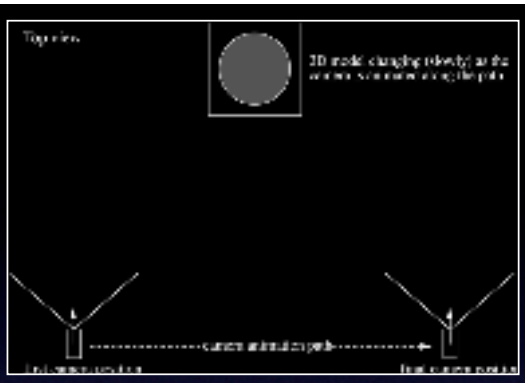
- Arose from researchers who use 3D displays but can't convey the data in 3D at conferences or on posters.
- Novel methods of displaying research provides promotional opportunities.
- Holograms are a "recording" on film of the interference of light reflected off an object with direct light (called the reference beam). The virtual object is created by illuminating the recording with light similar the original reference beam, the virtual object is created by diffraction.
- Most likely all holograms you have seen are of physical objects.
- The holograms discussed here are of synthetic objects, for example, datasets. One can imagine creating the point light field (light reflected off object) by large numbers of computer renderings, each from a different position in front of the object.
- These holograms are an approximation (only horizontal parallax) but have some advantages over traditional holograms:
  - are full colour (no rainbow effects).
  - can be illuminated with standard lights, halogens.
  - can incorporate smooth animation.

Rock dataset

Lumogram examples.

Volumetric dataset (Placoderm fish "teeth")

Note different views from different positions.



Dynamic Hologram

- As one views the hologram from different horizontal positions, it can change slowly.
- In the following example the isosurface value is changed from the density of bone (left) to the density of cloth/wood (right).



Mummy dataset.
MONA

Leveraging gaming software

- Large investments being made in software development for the gaming industry.
- Games often have similar requirements to many visualisation problems: highest possible visual quality at realtime interactive frame rates.
- Can we leverage first person shooters (for example) for visualisation.
  "Player" explores datasets rather that engaging in virtual killing?
- Exploration over the last year include:
  - SecondLife, targeting the collaborative aspects.
  - Unity game engine, developed support for stereoscopy and fulldome.
  - iPhone and iPodTouch applications, mobile devices for visualisation.

Representation of Aspirin molecule.

Discussing ASKAP wide field array site.

SecondLife

- Supports a large number of players in a 3D virtual world.
- A potential environment for collaborative science visualisation?
- Developed various tools that enabled data to be imported and represented in SecondLife rather the more usual manual modelling.

Molecular datasets

Lorenz attractor
Run simulations themselves within SecondLife?

Volumetric data (fluid dynamics simulations)

Unity Game Engine

- Cross platform (Mac, MSWindows).
- Scene graph and full physics engine.
- Programming: JavaScript, Boo, Objective C.
- Modern OpenGL features / capabilities.

ASKAP site visualisation

Mawsons hut (Peter Morse)

Island demonstration virtual environment

LadyBug filming

- Similar interactive surround vision as that was discussed earlier for immersive exploration of datasets.
- Installed at the Wollongong Science Centre to present University research.

University of Wollongong - Intelligent Polymer Research Institute

Karratha ship loader

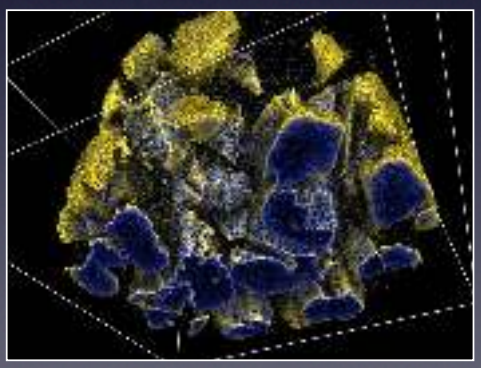
Rio Tinto - Remote operations

Questions?

- Please feel free to ring or visit if you have visualisation requirements I can assist with.
  Or if there is anything discussed here today that you would like more information about.

- The infrastructure items at WASP are freely available for use by researchers at UWA.

- Send me an email if you would like a copy of the visualisation showreel DVD prepared for APAC 2007 or OzViz 2008, showcasing visualisation outcomes from Australian researchers.



Volume rendering - Volcanic rock

Volume rendering - Fossil bone: CT scan data