Digital Fulldome as an Immersive Environment for Visualisation: Projects in 2009

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Contents

- Volume visualisation under the dome.
  Fulldome production based upon visualisations from Drishti.

- Dome support for the Unity game engine.
  Application to the Australia Square Kilometer Array Pathfinder.
  Application to virtual heritage: Mawsons huts, Antarctica.

- Interfacing Google Sketchup with the iDome.
  Immersive architectural visualisation.

- Dome support for the Blender Game Engine (BGE).

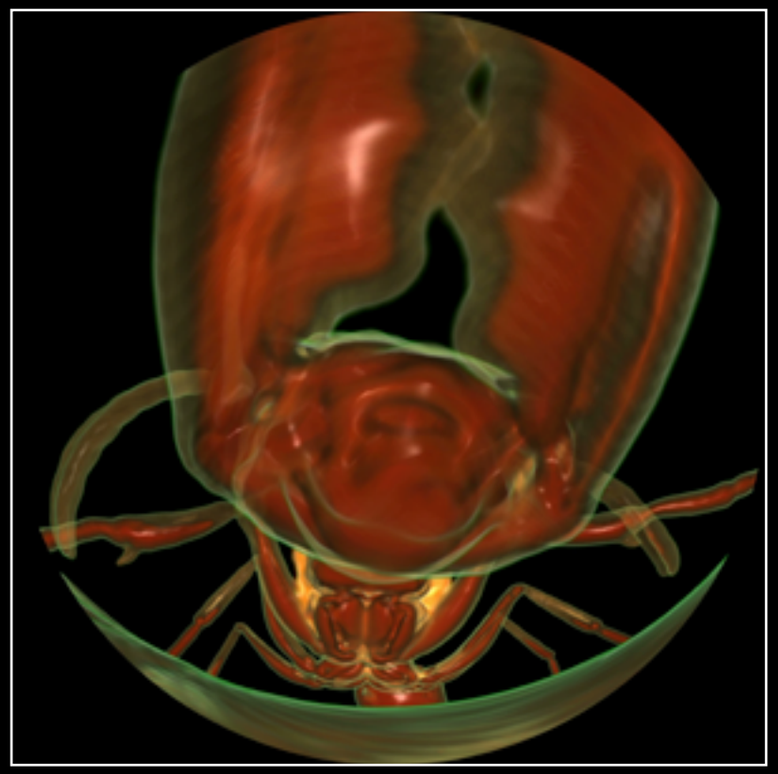
- Remote operations.
  iDome as the user interface, realtime surround video captured with the LadyBug-3 camera.

- Wollongong Science Centre public outreach exhibit for the
  ARC Centre for Excellence for Electromaterials Science.

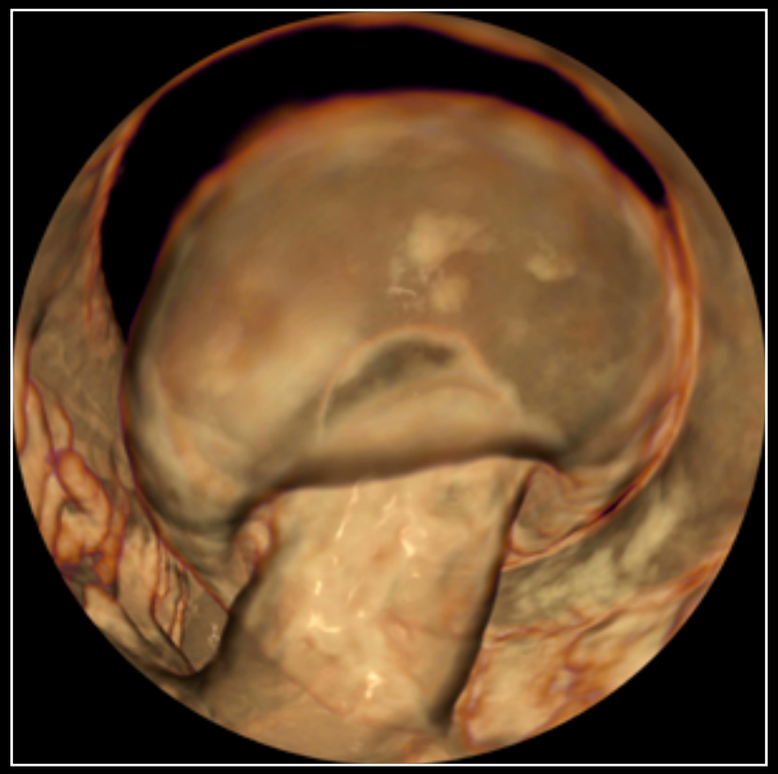
Volume visualisation under the dome

- Joint digital fulldome project in collaboration with Ajay Limaye, Tim Sendon, and Alexander Mitchell (music composition and performance).
- Cubic map render support added by Ajay as an animation export format. A standard way of creating fisheye images from packages without explicit fisheye support. While the rendering load is higher than just rendering a fisheye, it has as the advantage that the same cubic maps can be post processed to form fisheye movies for any orientated dome (0 [planetarium], 30 [Horizon], 45, 60, 90 [iDome] degrees are the most common).
- Originally prepared as a demonstrator for curators at Museum Victoria, to be projected onto the Melbourne Planetarium.
- Picked up and ran daily for 9 months during 2009 at Horizon Planetarium (located within SciTech) in Perth as part of their "late show".
- Shown at the 2009 ASTC (Association of Science and Technology Centers) annual conference at the Fort Worth Museum of Science and History, Nov 2009.

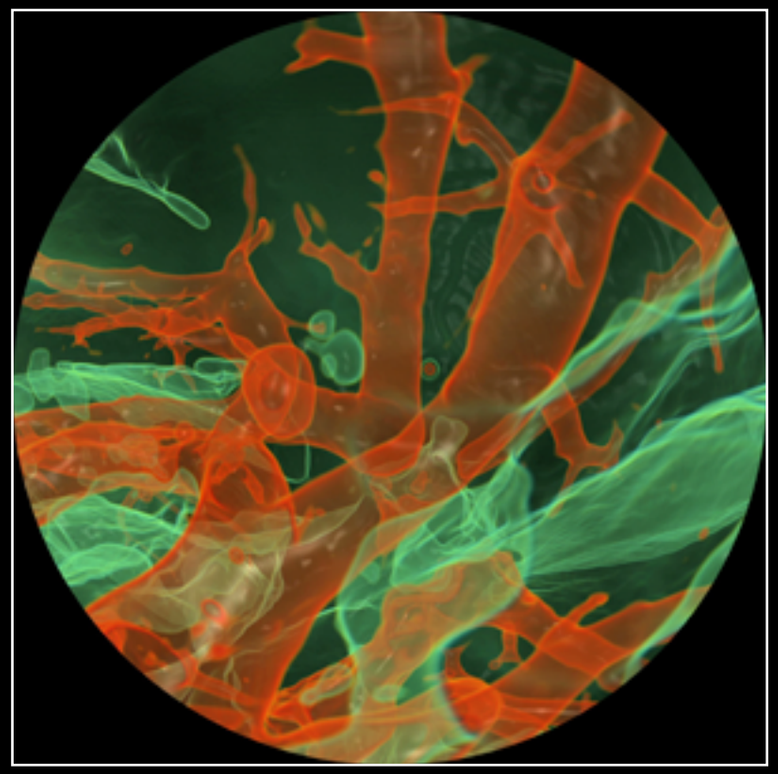
  [Full length version can be found on the OzViz 2009 visualisation showreel DVD]



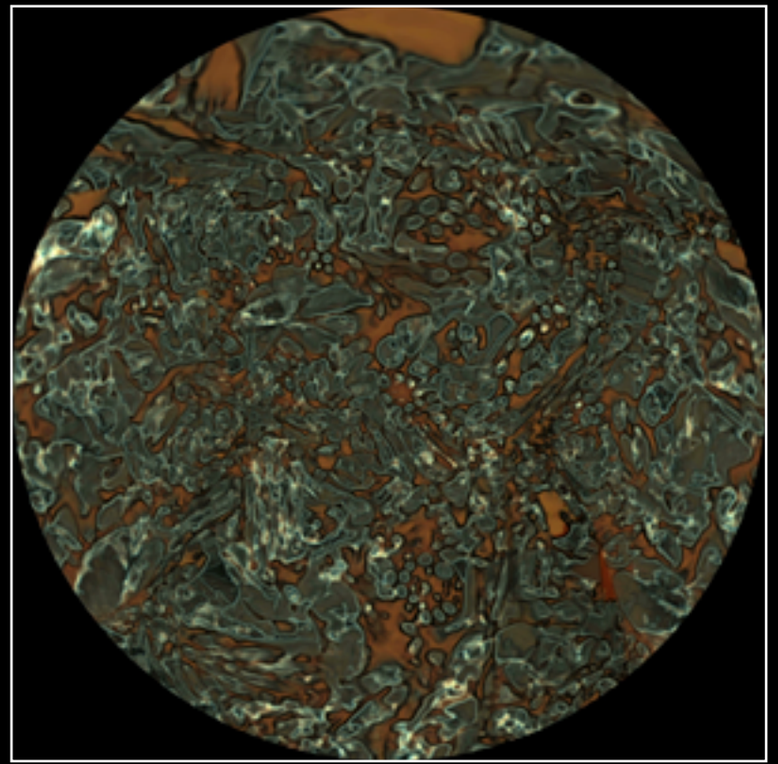
Terror Ant



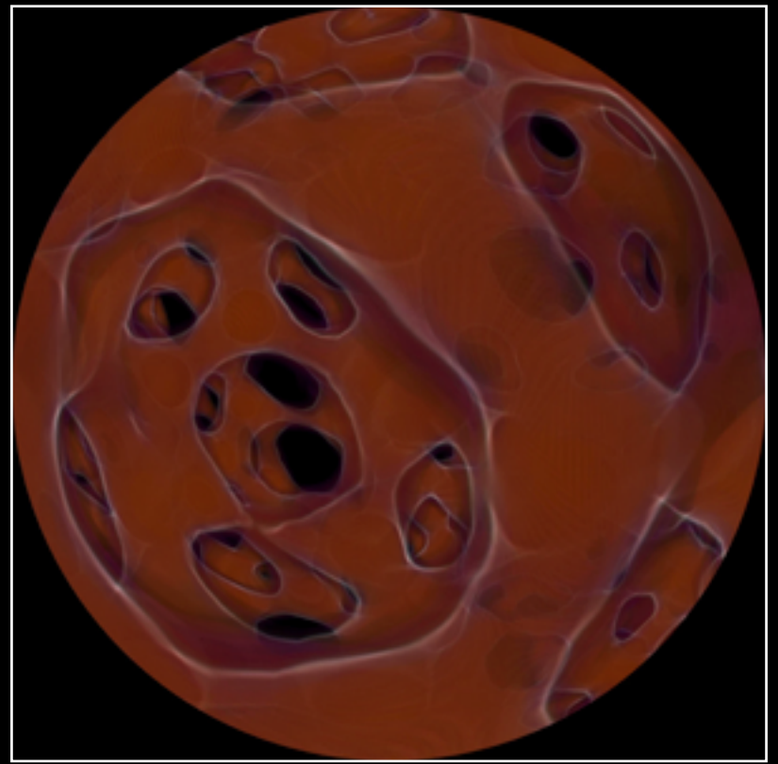
Ear of a fossil whale



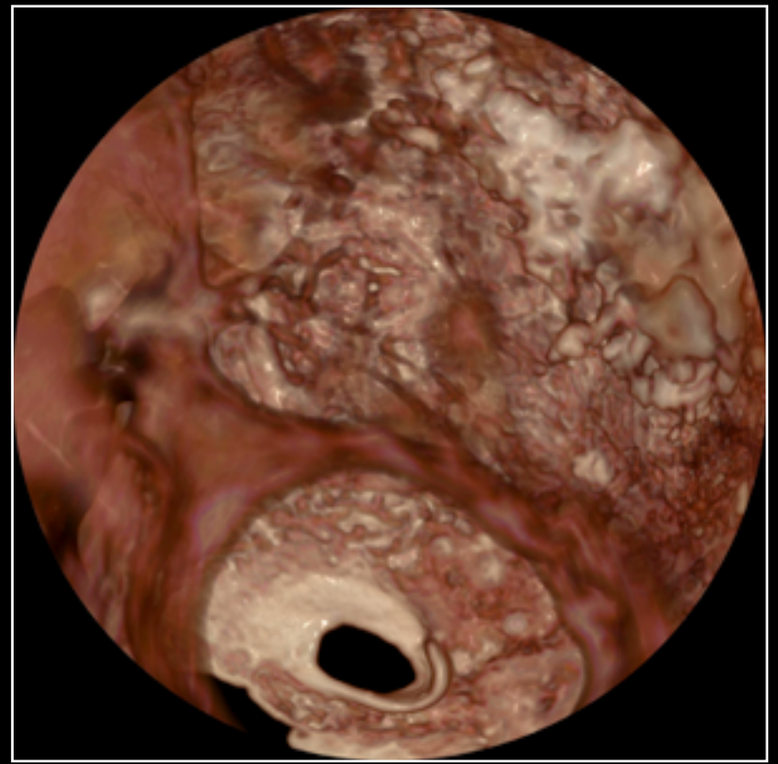
Rabbit Liver



Mt Gambier limestone



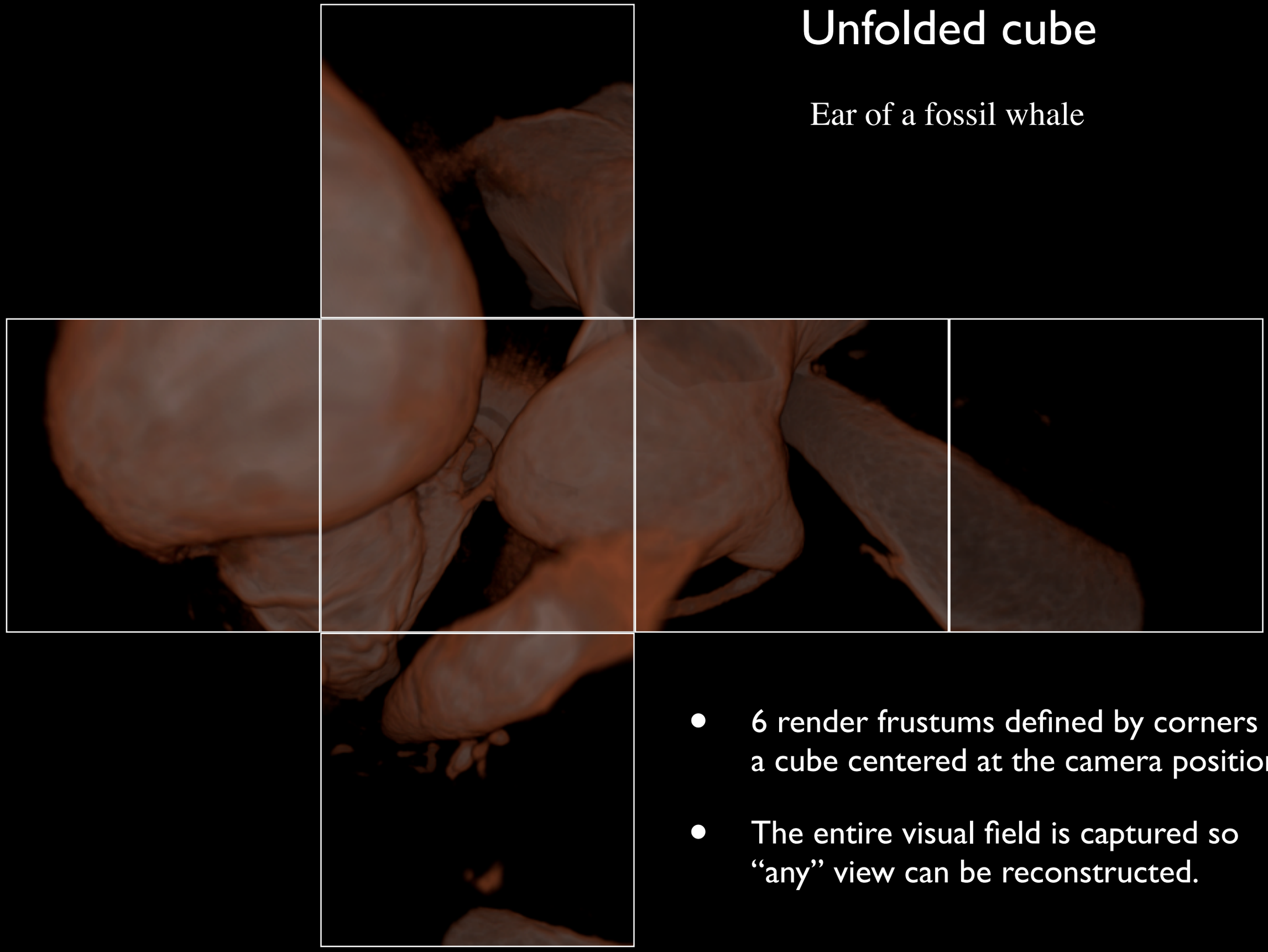
Reticulite (Rock)



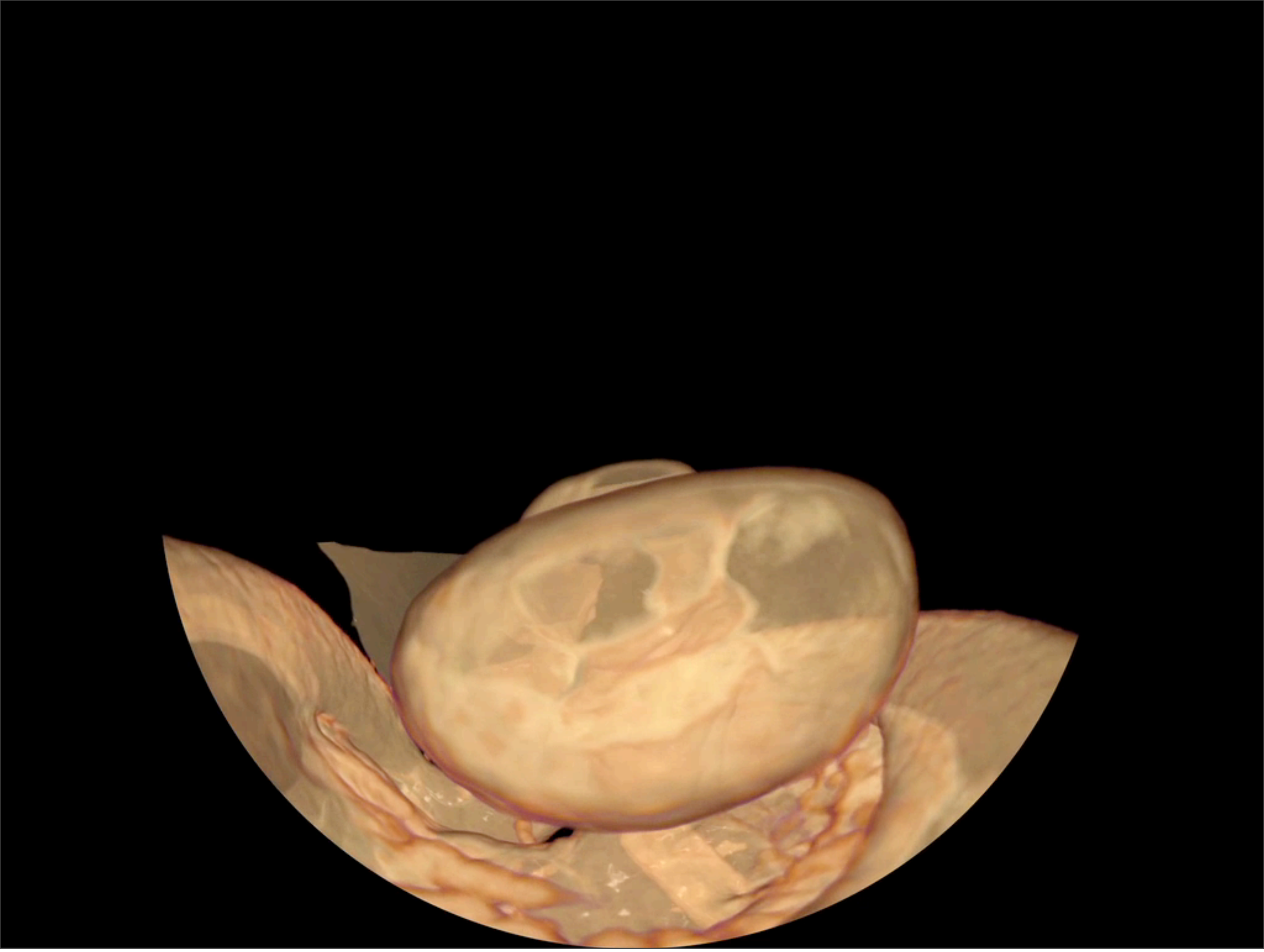
Gogonasus skull (fossil fish)

Unfolded cube

Ear of a fossil whale



- 6 render frustums defined by corners of a cube centered at the camera position.
- The entire visual field is captured so “any” view can be reconstructed.



Dome support for the Unity Game Engine

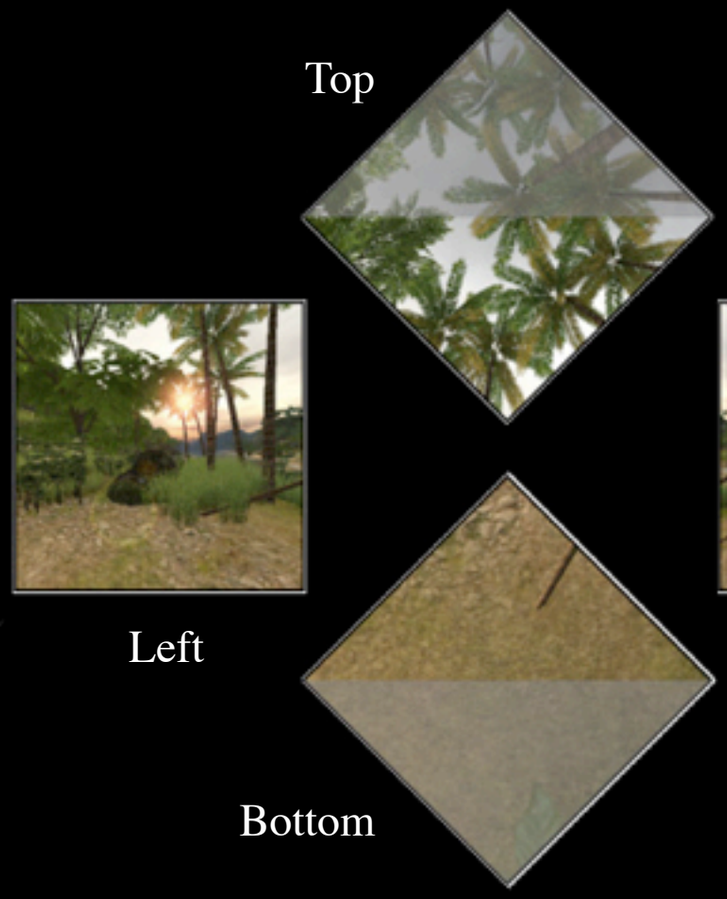
- Part of a general move to leverage game engines and the large investment in that industry for more serious activities. More commonly know as “serious games”.

- Chose Unity mainly for its capabilities but also ...
  - for its favourable licensing model.
  - cross platform support.
  - strong user community.

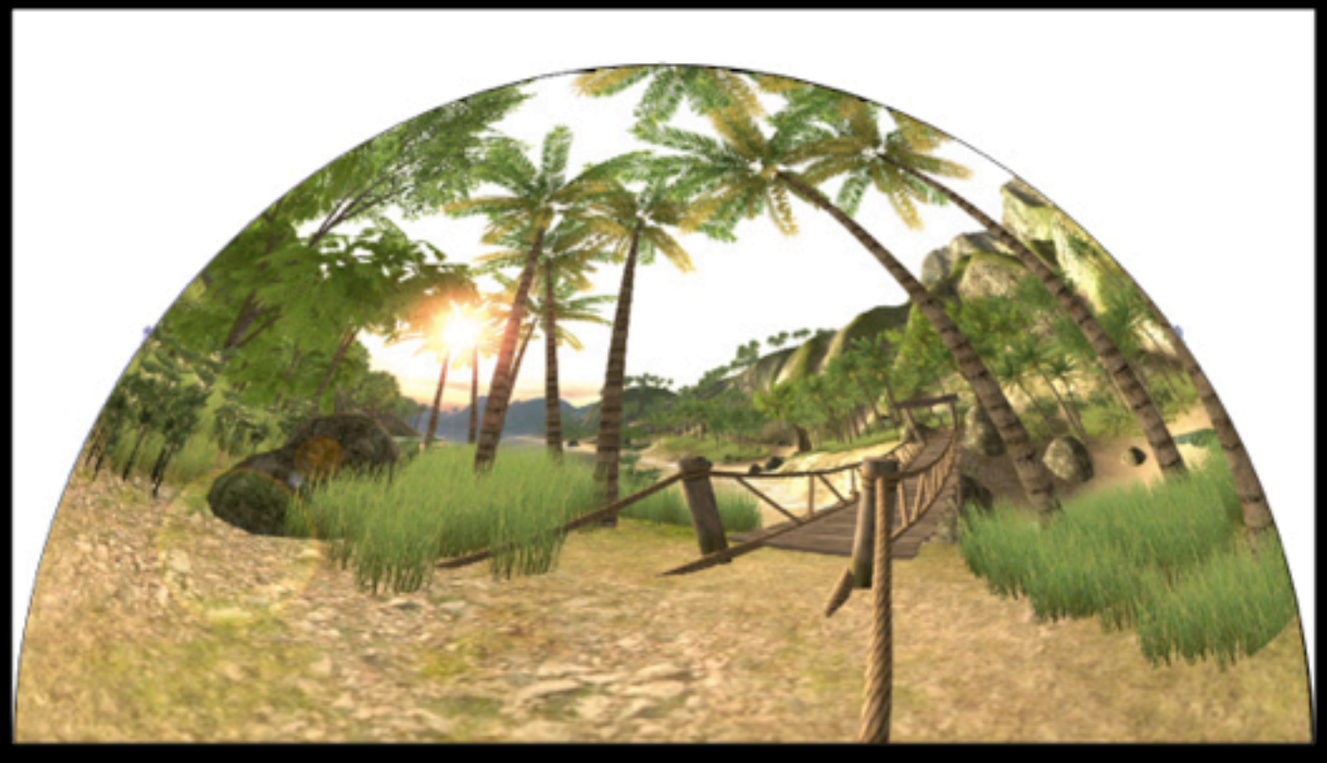
- The fisheye implementation requires Unity Pro for the render-to-texture support, also required for the side-by-side stereoscopic 3D implementation.

- Same technique as described for Drishti except we only create as many cube faces as necessary (4 required for the iDome) in order to maximise performance.

Example from demo game (Island) supplied with Unity.



- Multipass rendering: 4 cubic map texture render passes, one texture application pass to create a fisheye image, one texture application pass to create a warped fisheye for the iDome.
- Main performance hit is the 4 render passes, texture/mesh passes typically contribute less than a 1fps penalty. Overall a 2.5 performance penalty over a single flat display.

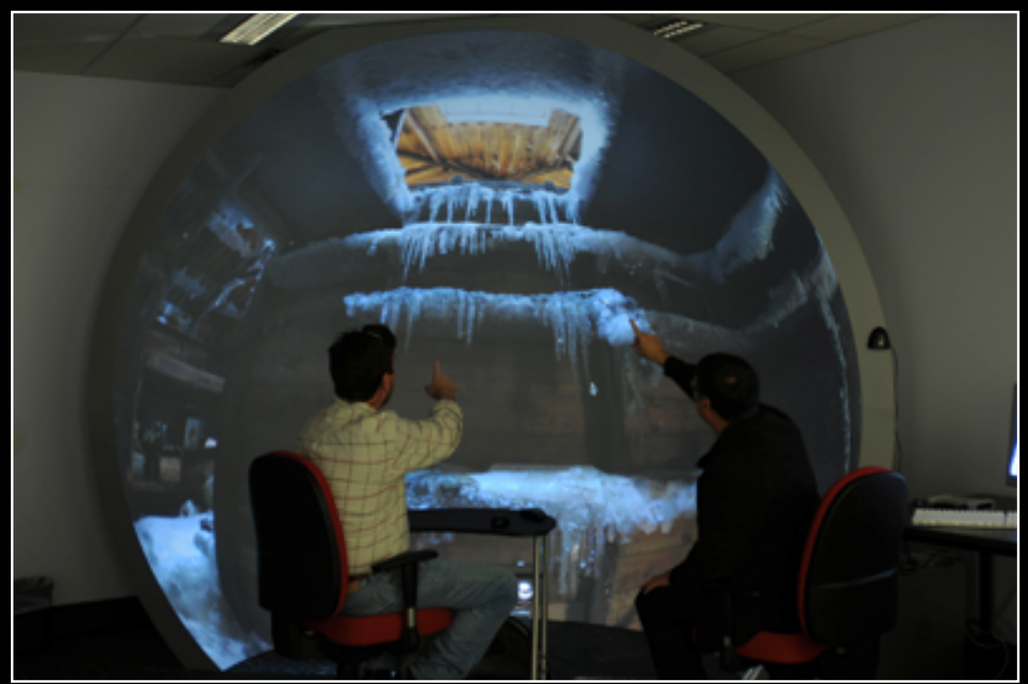


Application to virtual heritage: Mawsons huts

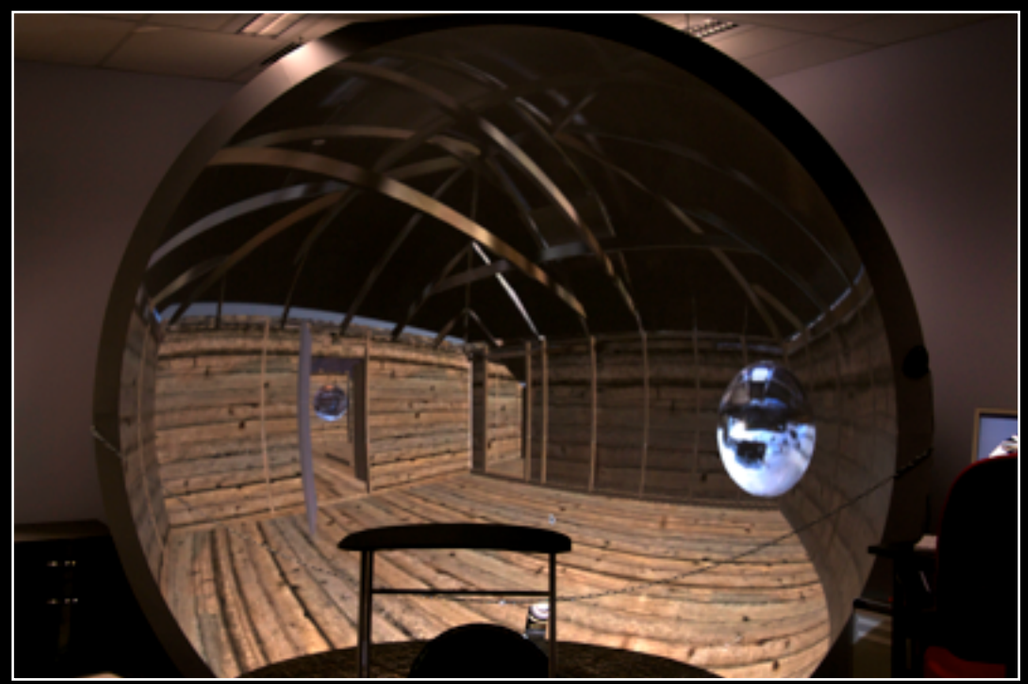
Incorporates high resolution spherical panoramic images within a virtual 3D model of the hut.

Project in conjunction with Peter Morse.

Exterior of the hut.



Within a spherical panoramic bubble.



Within the virtual hut model.

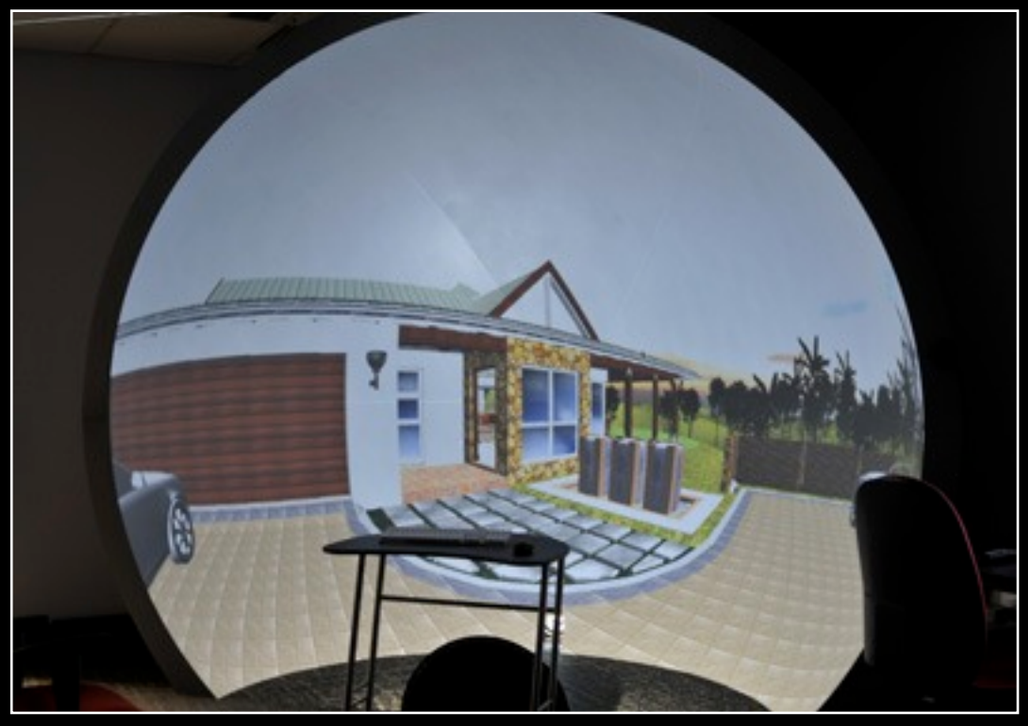
Application: ASKAP

Application: ASKAP

Architectural visualisation: Sketchup

- Goal was to produce immersive architectural walkthroughs of Google Sketchup models.
- Needed to be a very quick process so customer could move almost immediately from Google Sketchup into the iDome.
- Implemented a converter between Sketchup and Unity.
- Post-processing stages can improve the rendering results
  - Add an improved lighting model.
  - Replaced Sketchup plants with higher quality representations.
  - Are able to place the building on a more realistic terrain model.

Google Sketchup



iDome

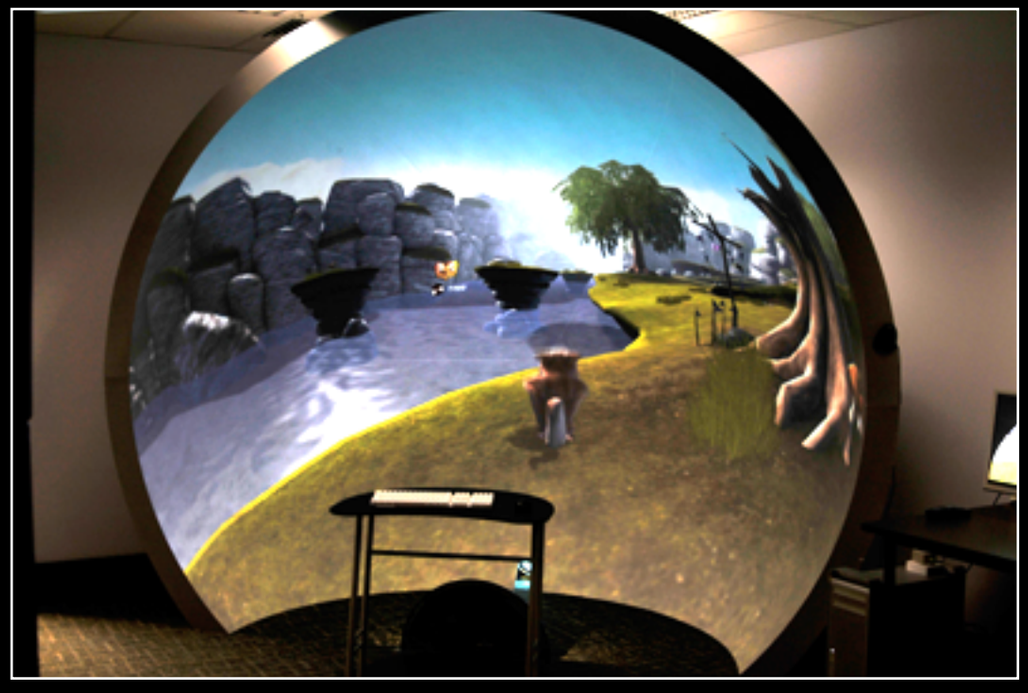
Google Sketchup

iDome

Thursday, 3 December 2009

Dome support within the Blender Game Engine

- In collaboration with Dalai Felinto, EAU / Universidade Federal Fluminense, Brazil.
- Employs the same multipass algorithm as implemented in Unity, but implemented in C/C++. Currently working on vertex shader version.
- The general fisheye and warped fisheye implementation now supported in releases from version 2.49 onwards of the BGE. Suitable for realtime applications for arbitrary orientated domes with spherical mirror, fisheye, or multiprojector display installations.
- BGE / iDome capability complete. Current evaluation project using it as a driving simulator for a personalised qualitative measurement of acceptable blood alcohol level.



YoFrankie

Club Silo

SAT - La Societe des Arts Technologiques, Montreal, Canada

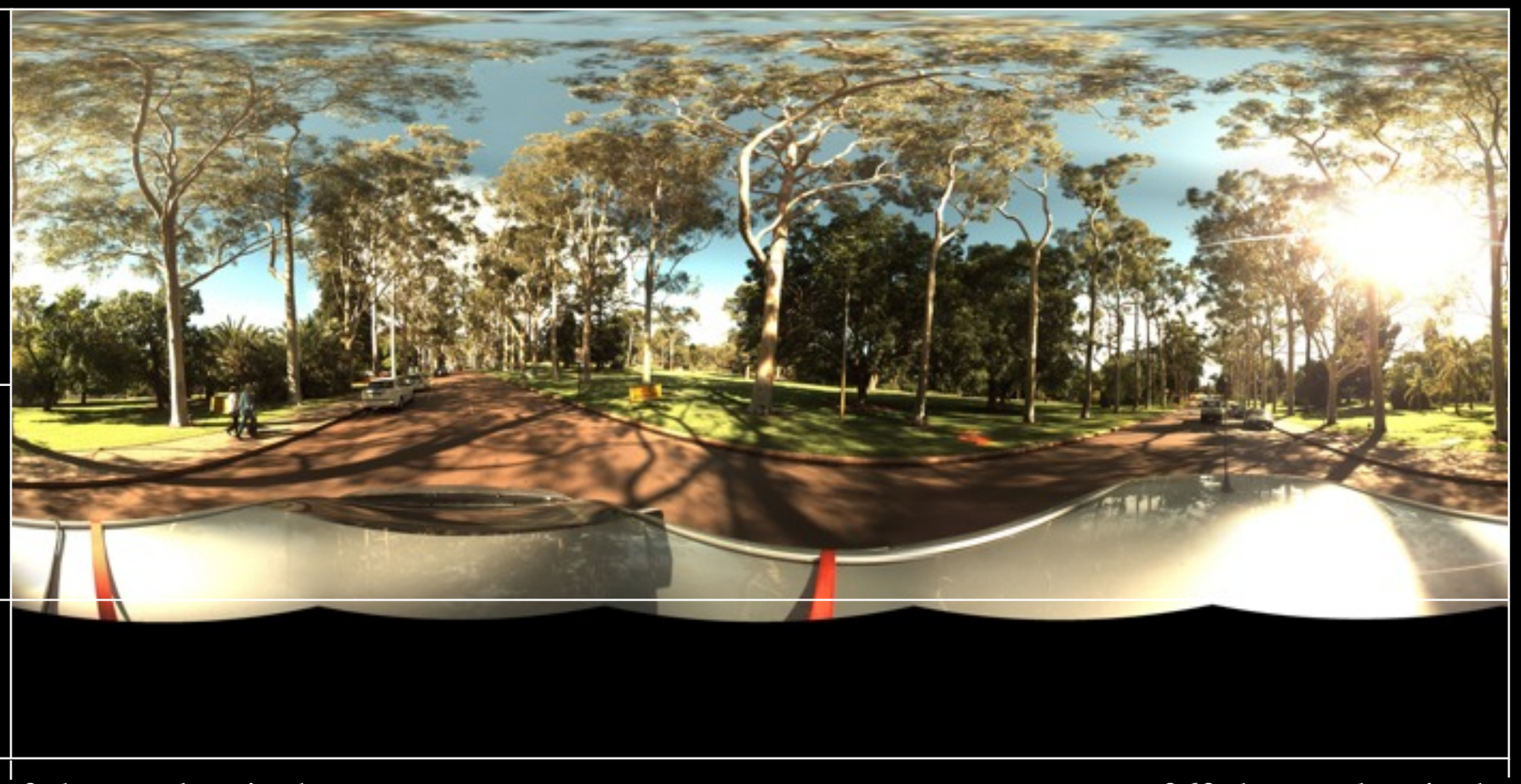
Remote Operations: Immersive video

- In collaboration with CSIRO Division of Exploration and Mining.
- Basic principle is to remove the operator from a hazardous work environment.
- Key requirement for the operator is to be able to see the whole operation in realtime.
- This exploration mounts a LadyBug-3 camera with a 360 degree field of view in the same location as the current operators cabin and stream the footage a few kilometers away to a more pleasant and safer work environment.

Shiploader, ship on left, iron ore conveyer on left.

Loading boom over the ship, operator booth at the end.

LadyBug-3


90 degrees latitude
0 degrees latitude
~ -50 degrees latitude
-90 degrees latitude
0 degrees longitude
360 degrees longitude
Spherical projection

Thursday, 3 December 2009

Spherical projection from the LadyBug-3 camera.

LadyBug mounted upsidedown (don’t care about the sky).
5400 x 2700 pixel movies @ 16fps.

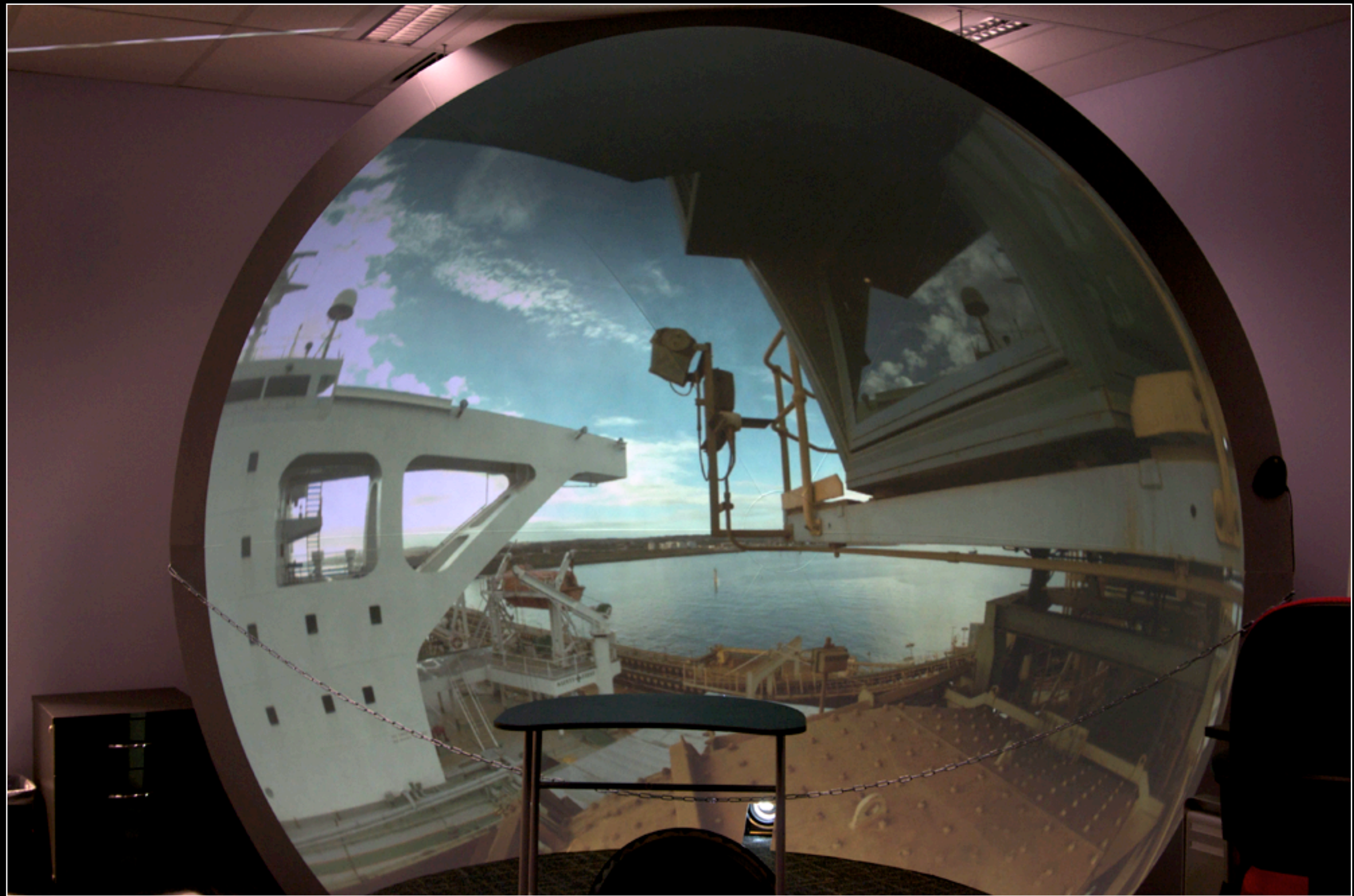


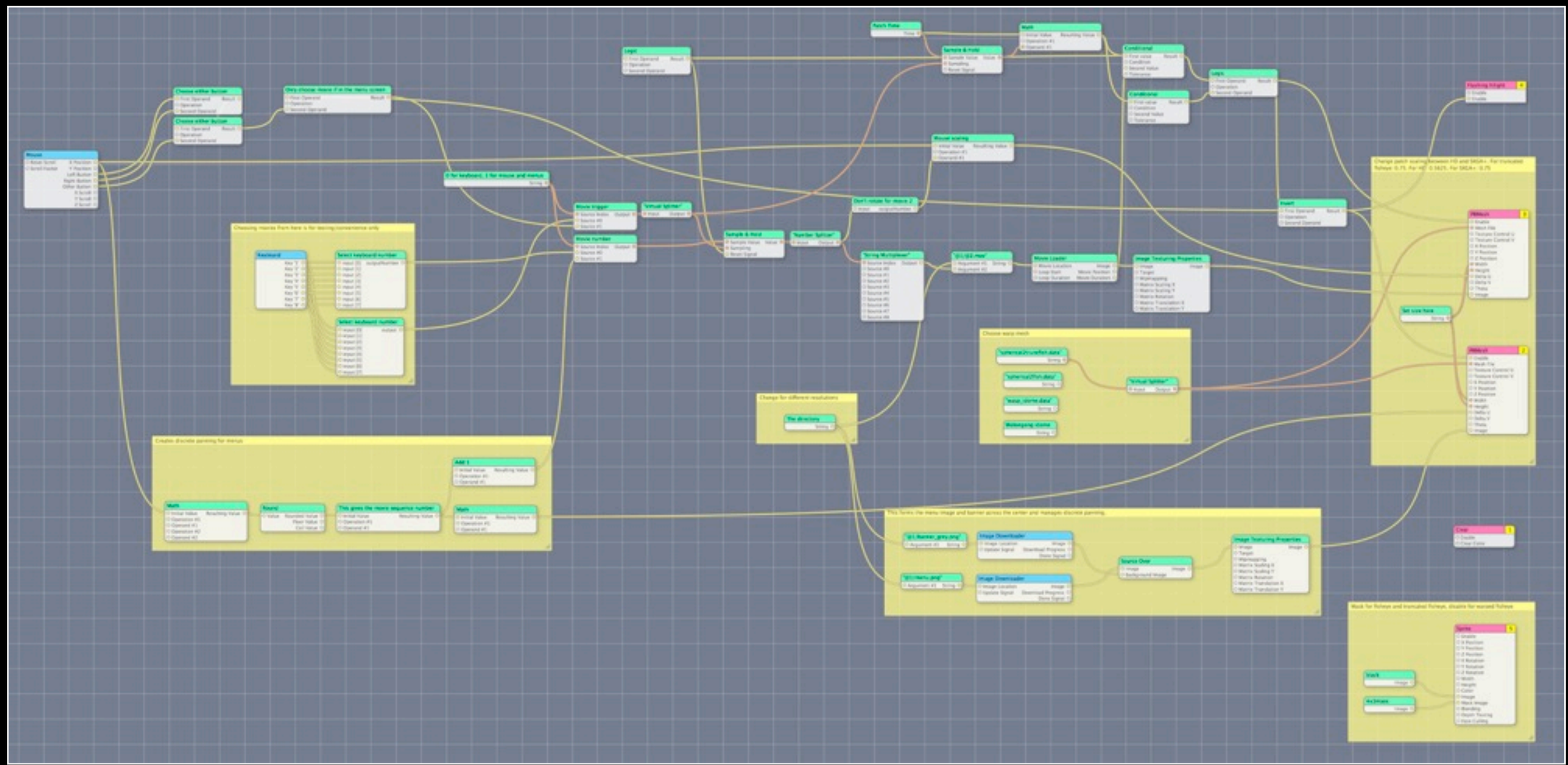
Image in the iDome, operator can pan around in realtime as the video plays (or is streamed in).

Wollongong Science Centre Exhibit

- In collaboration with the Wollongong Science Centre and the ARC Centre for Excellence for Electromaterials Science (ACES). Contributions by Mike Kuiper (VPAC) and Mats Bjorklund (Magipics).
- Aim was to provide visitors to the science centre with an interactive immersive experience based upon the science being conducted in the laboratories at the ACES.
- Exhibit was based upon the iDome to give the viewer a sense of being inside the laboratories.
- 360 x 150 degree video footage captured using the LadyBug-3 camera.
- CG material such as molecular models and simulations were composited into the spherical panoramic imagery, the user can both look around the laboratory or navigate to view the molecular inserts.
- Developed workflow to render simulations performed in NAMED by Mike Kuiper as spherical panoramic projections. Used VMD and custom scripting to create spherical panoramic images.
- Final control system and user interface developed in Quartz Composer.

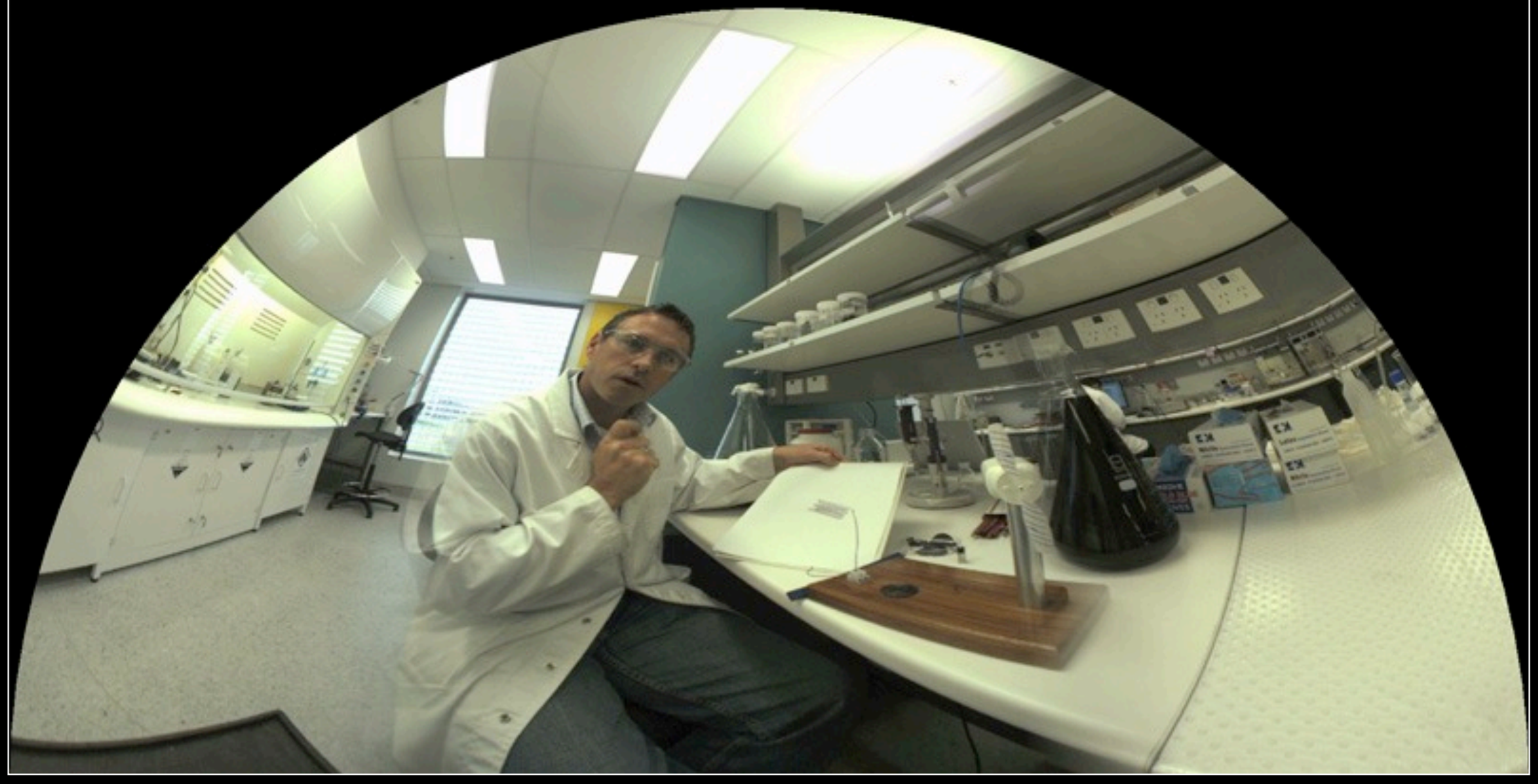
  [Demonstration on the OzViz 2009 Visualisation showreel]

User interface, viewer selects from 8 topics.



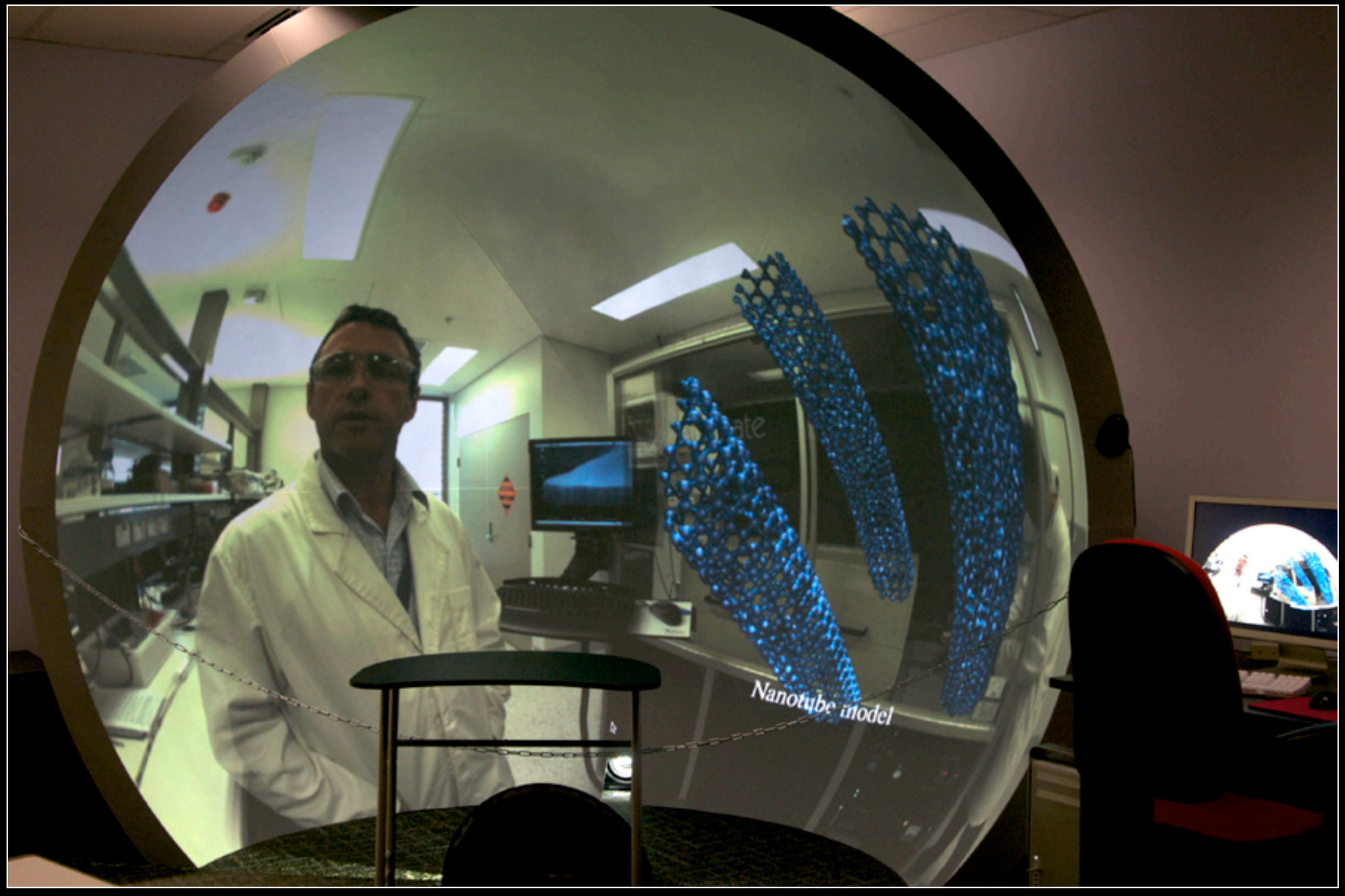
Interface developed in Quartz Composer

Single frame from Ladybug-3 camera.
5400 x 2700 pixels
16 fps



Warped image as projected into the iDome.
(HD projector)

View in the iDome.



Example of composited molecular geometry and simulations.

- Further reading:

  - iDome: Immersive gaming with the Unity game engine.
    Proceedings of the Computer Games & Allied Technology 09 (CGAT09),
    Research Publishing Services, ISBN: 978-981-08-3165-3, pp 265-272.
    http://local.wasp.uwa.edu.au/~pbourke/papers/cgat09b/

  - Blender game engine and immersive gaming in a hemispherical dome.
    (Submitted)
    http://local.wasp.uwa.edu.au/~pbourke/papers/blender10/

  - Wollongong Science Centre iDome exhibit.
    http://local.wasp.uwa.edu.au/~pbourke/exhibition/Wollongong/

- Questions?