Fulldome Activity Report
Paul Bourke
Director, iVEC@UWA

Unfortunately I am unable to attend the APS AGM this year but attached is a report on dome related activities by myself since the 2010 APS. My contribution to the projects outlined here ranges from consulting, acting as a hardware supplier, providing software tools and support, to full system integration. I've provided a brief one page description of each project, please feel free to contact me if you would like further information.

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As an aside I think there have been two exciting pieces of hardware released this year.

One is the F35 projector from Projection Design. A full 180x180 fisheye inscribed in the 2560x1600 projector frame results in a 1600 pixel square image. In the truncated configuration it is a 2560 pixel fisheye but only 180x112 degrees. However a pair of these projectors with a single edge blend results in a 2560 square fisheye, this is a very interesting cost effective solution for a reasonably high resolution installation. It certainly blows any other twin systems out of the water in terms of resolution (4K excepted). Note that from an operational point of view it is also attractive because the twin projectors can readily be driven from a single computer. Along with a fisheye lens this is available commercially from both Elumenati and Digitalis, but one can source the projectors and fisheye lens independently.

The other is the Kinect camera from MicroSoft, although they have only licensed it from PrimeSense. This camera provides some interesting possibilities for wireless interfaces, it makes many camera based tracking problems vastly simpler. For planetariums it has the advantage that the depth camera works in the dark since it is based upon an IR laser. Sound Chamber (see later) use this camera. As a software developer the opensource drivers and APIs for the Kinect make it particularly simple to integrate camera tracking into ones existing software. For initial tests see the following:

http://paulbourke.net/miscellaneous/kinect/

ASKAP fisheye photography

In June 2010 myself and Jonathan Knispel visited the ASKAP (Australian Square kilometer Array Pathfinder) site on the Boolardy station. There were a number of goals, one being to capture video of the dish rotating through all three axes, a unique feature of the design and a requirement for the interferometry process. At the time of this visit the first dish had been installed and was mechanically operational. The foundations for the next 5 dishes (out of a planned total of 35) were in place in June 2010 and those dishes have now been constructed.
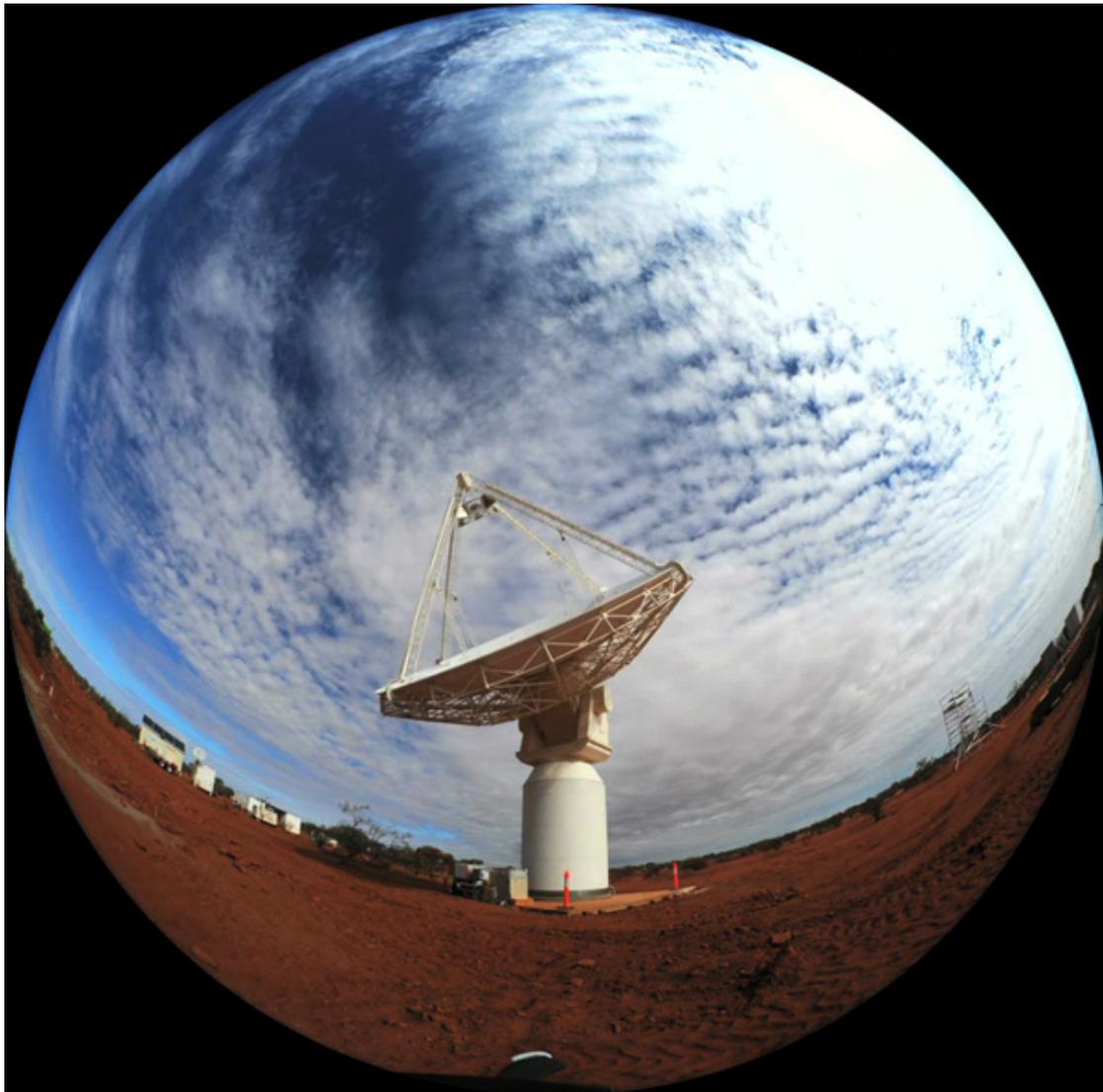
Various high resolution gigapixel images, movies, fisheye images, and kmz files for Google Earth can be found at the following link, there are also some geo-located photographs on GoogleEarth.

    http://paulbourke.net/fun/Boolardy/

Original full resolution fisheye and LadyBug-3 frames are available on request.

Hang glider simulator by Thomas Verbeek

An interesting vertically orientated dome project is a hang glider simulator by Thomas Verbeek at the University of Otago. Similar to the iDome in concept and it uses the same spherical mirror projector but it is not a solid surface and is larger than the iDome.

Summary by the developer

> *"Hang Glider Simulator was a Summer Scholarship project I developed during summer 2009-2010. The user is suspended in a harness attached to a large steel frame. A simulated environment is displayed to the user using a large hemispherical domed screen and a projector system. They are tracked by a small Firewire camera, and interact with the system by shifting along a bar. This results in the user interacting in a realistic hang gliding scenario in an immersive environment."*

For more information on the project see the following:

http://www.thomasverbeek.com/dev_portfolio.php

Spherical mirrors in fixed domes

Fort Lupton (Colorado) is one example of a number of planetariums across the USA installing the spherical mirror projection system. There is no suggestion that the image quality compares to multiple projector systems although if installed/configured well it can easily complete with most single projector fisheye systems. A great advocate of this technology in the USA has been Jack Dunn at the Mueller planetarium.

ePlanetarium offer commercial solutions based upon the spherical mirror, as do others. But many realise they can largely manage the installation themselves with the online material available and a support network through myself, Jack, and others.

The Sri Sathya Sai Space Theatre is one example from a number of spherical mirror installations that were created during 2010 in planetariums in India. The popularity in India is partly due to the early deployment in the Bangalore planetarium and the more recent system in the Chennai planetarium. One development in 2010 was the sourcing a second supplier of first surface mirrors, this not only provides some future proofing of that key component but the new mirrors also have a protective coating applied making them more robust and thus attractive for portable systems.

Sound Chamber by Yvette Coyne

Sound Chamber is an interactive audio visual installation by a local (West Australia) artist Yvette Coyne. Video captured of participants is converted into audio and imagery which is then projected onto the dome.

Description by the artist

> *"The Sound Chamber is an interactive sound art installation. The aim of the piece is to provide the user with a unique and immersive experience whilst they directly interact within the space.*
> *Set inside a large inflatable dome, a person's movement is detected by cameras. The custom computer program manipulates their 'image' and projects reactive visuals onto the roof of the dome. When the person moves, they create sound. A computer program converts the colour density, object movement, object size and position on the screen into sound density, transposition, speed and spatialisation. The acoustics and the insular environment within the dome create a unique experience.*"

The dome itself is a 6m diameter inflatable with two rings to raise the spring line. It uses a spherical mirror projection system but one enclosed in the ePlanetarium Newtonian stand. The Newtonian employs a folded light path using an additional planar mirror, this reduces the space required for the projector hardware from around 1.2m (for direct projection) to less than 0.4m. The camera tracking employs the Kinect camera, using the IR derived depth map of which solves most of the issues of filming within a dark space.

The installation was tested at the XMediaLab hosted in Perth in April and officially launched at SciTech in May. For further information see
    http://soundchamber.abc.net.au/

Domelab 2010

Our centre at the University of Western Australia hosted "DomeLab 2010" from the 31st December to the 5th November 2010. The event was funded and managed by ANAT (Australian Network for Art and Technology). Vicki Sowry organised and managed the event. Tutors included myself, Peter Morse, Warik Lawrence, Ben Shedd, Jonatahan Strawn, and Hue Walker. There were 23 participants from across Australia for what was an intensive week of exploration into filming and storytelling for fulldome.

Previewing of content during DomeLab was in a small 5m inflatable (courtesy of Martin Ford of SpaceTime Inc) and a GeoDome (courtesy of Nick Cross from AARNET). The 5m inflatable used a spherical mirror projection system and the GeoDome a SXGA+ fisheye system from elumenati. In my opinion the GeoDome is easily the best inflatable system I have seen, if only because it doesn't need an airlock. A fisheye view from the doorway is shown below.

For more information on the event see the following:
    http://domelab2010.anat.org.au/

Kuching planetarium

In March 2011 I presented at the planetarium in Kuching, Sarawak, East Malaysia. This took the form of a talk based upon the science and technology challenges of the SKA (Square Kilometer Array) and was followed by two fulldome shows, "Realm of Light, a brief history of time" and "Kaloukahina, the enchanted reef" both courtesy of Reef Distribution and Softmachine. The abstract of the presentation is as follows:

> *"The Square Kilometer Array (SKA) will be the worlds largest radio telescope that will be at least 50 times more powerful than the current most powerful radio telescope. It will enable astronomers to see the formation of the early Universe, including the emergence of the first stars, galaxies and other structures. While the SKA will not be built until the 2020 timeframe, the Australia SKA Pathfinder (ASKAP) is being built now in the outback of Western Australia. In this presentation the SKA will be introduced followed by recent photography of the pathfinder dishes in Western Australia where the presenter is based. Also introduced will be the significant technological challenges of the project in terms of computing, networking, storage, and visualisation."*

The Kuching planetarium is 15m in diameter and is one of the first fixed planetariums in the world to use the Spherical Mirror system. It still has a working Zeiss star projector and as such gets the best of both worlds, high quality starfields and the ability to run digital fulldome shows.


The presentation slides can be found here
http://paulbourke.net/papers/kuching2011/

Martin Ford and SpaceTime Inc

In 2010 as part of the iVEC industry uptake program, I worked with Martin Ford of SpaceTime Inc. Martin Ford runs a dome based outreach program in West Australia based upon small inflatable domes and spherical mirror projection systems. The purpose of the collaboration was to explore stereoscopic 3D fulldome projection with the spherical mirror within inflatable domes.

Part of the collaboration involved developing a professional show controller for single projector based fulldome systems for the MSWindows platform. This allows a presenter to have a number of digital assets (applications, movies, slides, etc) and present them seamlessly to the audience. The package includes fisheye warping for spherical mirror based systems, as far as I am aware this is the first MSWindows based software that warps fisheye movies on the fly, my solutions are all Apple Mac based.

For more information see

http://www.mediawarp3d.com/
http://www.spacetime.com.au/
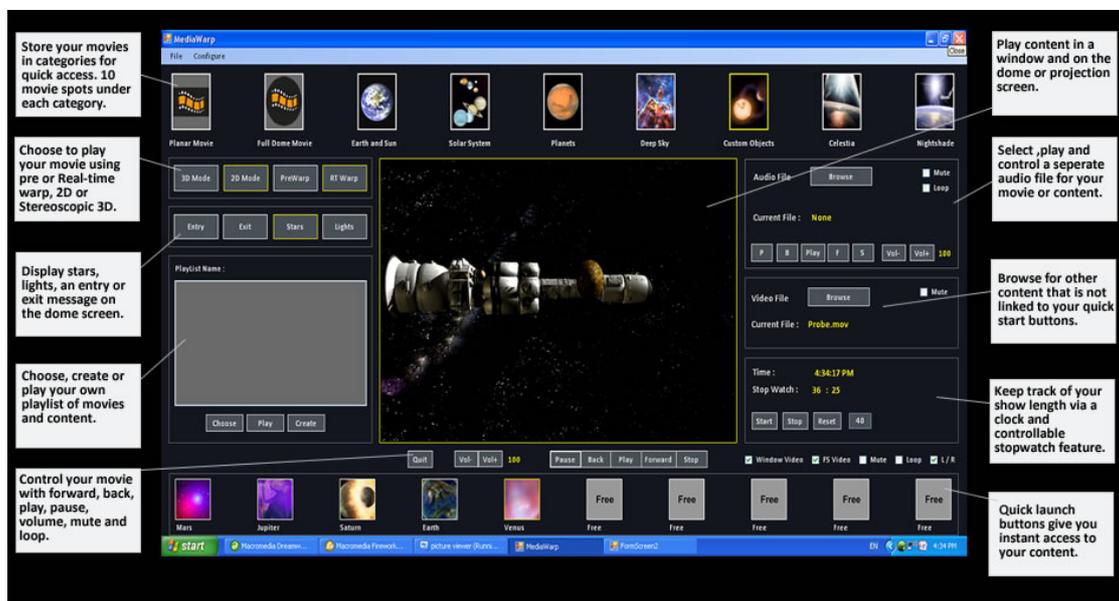
City University, Hong Kong

The ALIVE (Applied Laboratory for Interactive Visualisation and Embodiment) laboratory at the City University in Hong Kong is now established and includes some exciting environments, two of which are dome based.

The first is an iDome (3m diameter) with the standard spherical mirror and HD projector located on the floor.

The second is a 6m diameter inflatable with a central fisheye projection system arranged for full 180 degree projection. While this is an inflatable it is located permanently in the laboratory. The blower has been located in another room with a long pipe to the dome, this make the environment significantly quieter than most inflatable systems.

For more information see
http://www.cityu.edu.hk/scm/alive/visualizationsystems.htm
http://www.cityu.edu.hk/scm/alive/exhibits.htm

iDome

The iDome continues to be a popular environment for viewing/experiencing panoramic photography, LadyBug-3 footage, as well as science datasets.

There is currently a project underway to add fisheye and warped fisheye support to VMD (Visualisation of Molecular Dynamics), one of the more widely used tools for static and time varying molecular visualisation. This is being developed in conjunction with the VMD developers and will thus be a standard part of software in the future.