

## Planetariums — New tools for a greater impact

**António Pedrosa & Marco Silva**

Navegar Foundation, Centro Multimeios de Espinho (apedrosa@multimeios.pt, marco@multimeios.pt)

### Abstract

The International Year of Astronomy will be a celebration of astronomy. Planetariums will definitely be one of the major vehicles used to transmit its message. The digital technology that is now becoming available to planetariums will bring an enormous change to how planetariums work and to the possibilities and impact of the message they transmit.

The Espinho Planetarium, managed by the Navegar Foundation, has been dedicating its efforts to different areas of digital planetariums, including content creation and the development of software tools. In particular we would like to present two tools that have been developed recently for pre-rendered content production. We would like also to present a new tool, dedicated to test content under production and to perform real-time presentation of shows in the planetarium, integrating real-time sky simulations and the display of pre-rendered content.

### Introduction

The new millennium has brought a revolution to the planetarium world. Systems that can project digital footage filling the entire dome have become available. This revolution has, in turn, generated new challenges, one of which is the need for new content creation tools. Tools to handle digital content in cinema or on TV have been available for quite some time. However the fulldome paradigm is, in several aspects, quite different from cinema and TV, mainly due to the nature of the projection screen. To tackle this problem, plugins have been created to add new features to pre-existing digital tools, so as to be able to handle or produce dome content without the need to create an entirely new tool.

Another important requirement is the need to test content. Usually content is created and managed in a 2D projection of the sphere in the plane, which gives a good notion of the result, but can be misleading in many important aspects, due to the extremely wide image field involved. A testing tool that visualises content on a computer screen can also be designed to offer an easy and simple solution for small and portable digital planetariums, based on a single projector.

### Full dome, a composition tool for spherical environments

One of the main tools needed to handle digital video is a composition/editing tool. In traditional digital video the input footage that is processed and the final result are of the same type. Usually they have the same rectangular aspect, and apart from possible special effects, no image distort-

tions are involved. For fulldome, this is often not the case. The footage that is being composed is usually in standard format (recorded with a video camera or created using a standard camera in animation software), and both the compositing window and the final result are a projection of the spherical screen in the plane, usually a fisheye projection, see Figure 1.

A tool, called the FullDome plugin<sup>1</sup>, was designed to handle all the different aspects of dome content compositing/editing in the form of a plugin for Adobe After Effects<sup>2</sup>. Besides being able to distort the content to adapt for the curved surface screen, the software is able to place the footage in a specified position on the dome, now defined in terms of altitude (reference is the spring line) and azimuth (reference is North). A set of astronomical features is available that enable the precise location on the celestial sphere to be set, as well as simulating many astronomical phenomena. Although conceptually, the hemispherical surface tends to be more difficult compared with the traditional flat screen, the use of the plugin is very intuitive. The user imports content to the composition, sets up all the necessary parameters associated with the kind of input footage used, such as place and size.



Figure 1 – A fulldome frame in Fisheye and Cylindrical projection.

All figures courtesy of the authors

## WFCam4D — A wide field camera for Cinema4D

Producing content using animation software involves taking a sequence of images or a movie obtained by a camera available in the software. The types of cameras available are of a standard type and are intrinsically limited to a usable field of view that is not much in extent of 100 degrees. To render images involving a very large field of view (FOV), the usual procedure is to set up a rig of six cameras, pointing front, back, left, right, up and down, with a FOV of 90°, see Figure 3. The six images are then combined to create a single image that fills the entire FOV.

A plugin for the animation software Cinema4D<sup>3</sup> was designed to avoid all the intermediate steps, obtaining a single wide field image immediately. WFCam4D<sup>4</sup> simplifies the production phase considerably, and the images can fill the entire 360° by 360° FOV, see Figure 2. Many different types of image projections are available, including fisheye, orthographic, stereographic and others.

<sup>1</sup> <http://fulldomeplugin.multimeios.pt>

<sup>2</sup> <http://www.adobe.com/products/aftereffects>

<sup>3</sup> <http://www.maxon.net>

<sup>4</sup> <http://WFCam4D.multimeios.pt>



Figure 2 – A render of a scene using WFCam4D showing a full 360° field of view, in Fisheye and Aitoff projections.



Figure 3 – A 3D view of the projection in the planetarium, as seen from the dome centre.

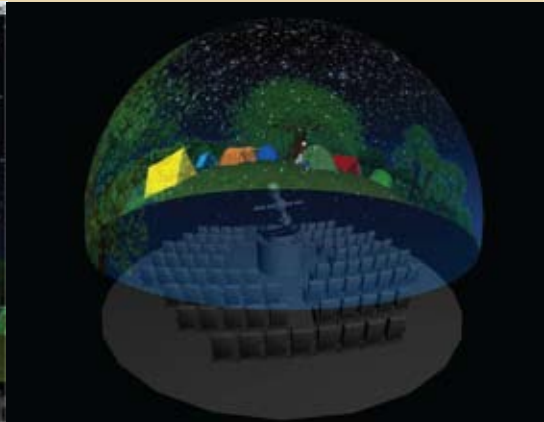


Figure 4 – A 3D view of the projection in the planetarium, as seen from outside. A planetarium model was added for a more realistic view.

All figures courtesy of the authors

## DomeView, software to view and preview dome content Goals

The content produced for full-dome projection is made in a frame (the Master) with a format corresponding to a projection of the dome on a plane. The standard is the fisheye projection, see Figure 1. Due to the distortions involved, looking at the Master does not give a clear idea of the final result once projected on a planetarium dome. One of the solutions is to use different Master projections, like those in Figure 1, or to go through an interactive process, with successive projections on a planetarium until the desired result is achieved. Repeated access to a planetarium is difficult, costly and time-consuming. So a tool was designed to give the user a clear notion of the final result in the planetarium directly at the desktop.

### Capabilities

DomeView<sup>5</sup> is a real-time tool designed to view and preview dome content. For previewing, DomeView displays the content projected on a spherical surface, like a planetarium dome, in 3D, see Figure 3. The viewing position can be changed, just as a spectator can change seats in the planetarium or even see the scene from outside the planetarium. A model of a planetarium can be

<sup>5</sup> <http://domeview.multimeios.pt>

added for a more realistic view, see Figure 4. The inclination can be set so the system can cope with many modern planetariums. This software is able to display the entire dome up to 360°. The viewing feature displays the content in a 2D projection of the dome and supports the projection in a dome using a single video projector, fisheye for example. The content can also be viewed in a spherical mirror projection. This enables a full dome projection to be done in a planetarium using a regular projector and a spherical mirror, see Figure 5.

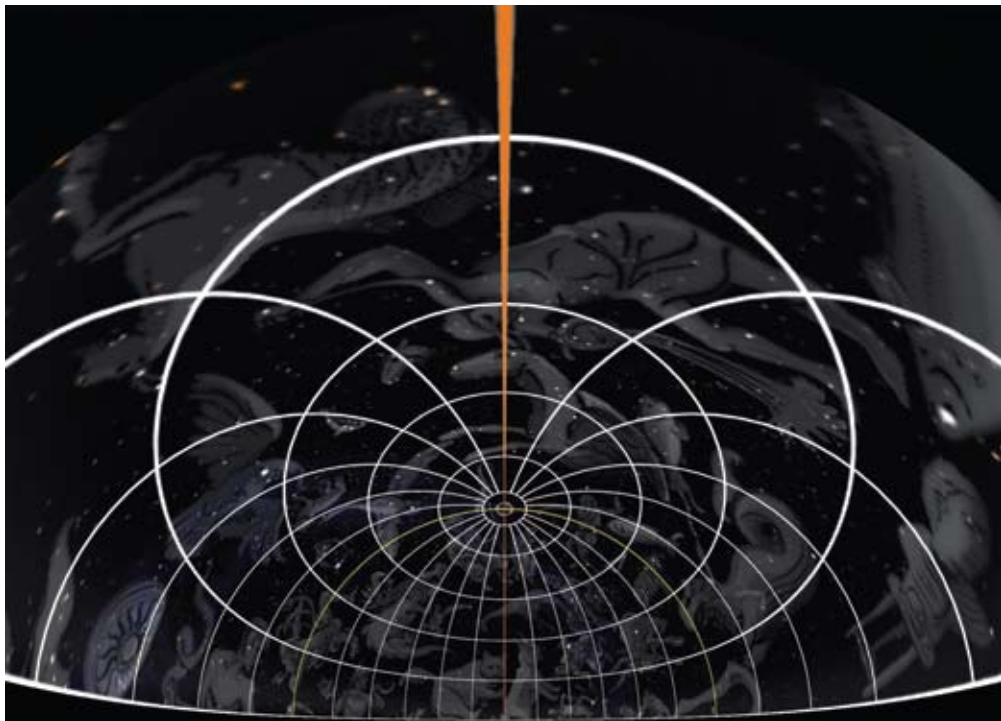


Figure courtesy of the authors

Figure 5 – A scene generated by Stellarium, distorted using the Spherical Mirror projection.

### Content

DomeView handles video and images of different types. The content can also arrive directly from third party programs, such as Adobe After Effects, Adobe Photoshop, the free open source planetarium Stellarium or a webcam. The media content is displayed according to the selected location in the dome, size and projection. If the media source is the FullDome plugin under Adobe After Effects, all options are disabled since the media is configured automatically.

### Features

The software has many features that makes it highly versatile, and suitable for several different uses:

- 3D previewing:
  - Spherical View, where the content is projected on a sphere.
  - Cylindrical View, where the content is projected in a cylinder.
  - 3D model imports, e.g. a planetarium model.

In the planetarium mode model, the viewing position can be chosen freely, both inside and outside the dome/cylinder.

- 2D viewing:
  - Fisheye projection, to project content in a planetarium using a fisheye projector.
  - Standard Projection, to project content in very small (1–2 m) domes using regular projectors.
  - Spherical Mirror Projection, to achieve fulldome projection in a planetarium using a regular projector and a spherical mirror.

DomeView accepts different types of media content, videos (.mov, .wmv, .avi, mpg, mpeg, etc) and images (.jpg, .gif, .bmp, .tga). It can also handle content arriving in real-time from other sources, such as Adobe After Effects, Adobe Photoshop, Webcam and Stellarium. It is hyperdome ready, being able to display content in dome with a spherical angle of up to 360°.

## Conclusions

We have presented a set of tools that have been developed by the Navegar Foundation, dedicated to fulldome applications. They cover different areas, from production to projection, and, although powerful, they are simple to use, requiring only a simple notebook, meaning that the user can concentrate on what's most important, the content itself.