Abstract. This summer the first public stereoscopic full-dome theatre in Japan will open at Science Museum. This new theatre will feature pre-rendered and interactive content, not only for astronomy but also for the wider field of science visualization, art, entertainment and more. We also developed an intuitive, easy-to-use presentation tool allowing the full-dome environment to be used for interactive talks and content development. In this paper I will describe the latest results of the original content and software development.

Introduction

We have been building the first ‘public’ stereoscopic dome theatre in Japan, at the Science Museum, in Tokyo, and will open this late summer. We named it the ‘Synra Dome’, where ‘synra’ means ‘everything in the universe’ in Japanese. This new dome theatre will be used not only to show astronomical contents, but also contents from various other fields of science, arts, entertainment, and more. For this dome theatre I have developed full-dome movie content workflow and a brand new presentation software for interactive live shows. In this paper I'll describe these new softwares that facilitates us the usage of the full-dome environment.

Movie Making Workflow

While creating the new full-dome movies, we quickly realized that none of us really had enough experience of dome show makings, especially when dealing with how objects and scenes get distorted on the dome screen surface, and how the audience would feel when watching them. So at first, I made a virtual dome-previewing tool called 'AllSkyViewer', with which one can project Dome Master movies on a virtual dome screen surface and check it from anywhere he or she wants.

It also works in actual dome environment and can be used as a rapid previewing tool to check low-resolution Dome Master movies without the need of pre-slicing. Using today's powerful PC clusters, we can check 1.5Kx1.5K Dome Master or 1Kx1K cubic faces quickly with OpenGL accelerated real-time slicing techniques. Using this virtual dome projection helps the graphics designers very much. We found that in some case, a user-defined safe area gives a better perception of scaling between virtual and actual domes.
I also added format/type conversion functionalities to the software making it useful in the content making workflow.

We found that the inter-conversion between Dome Master and cubic files is useful in the content making workflow. The latest versions of AfterEffects and Apple Motion have 3D scene composition abilities and come with lots of powerful F/X. We thus can convert our Dome Master footage to a 5 cubic faces files with AllSkyViewer (or render them out directly as such), and easily import them in the preferred 3D composition environment as a virtual cube around the camera. In this environment we can add images, movies, text layers, and 3D particles (remember, we must make stereoscopic dome contents). After that, we can render the composite scene as 5 cubic faces movies, and finally convert them back to a single Dome Master movie file with AllSkyViewer again.

With this optimized workflow, we are able to check and discuss about the dome content over and over again.

**Presentation Tool**

For this new dome environment, I developed a brand new presentation tool for full-dome presentation. It should be relatively easy to use, and powerful enough to make the most of this immersive environment.

I named it ‘Quadratura’, and it is currently the most powerful and extensible presentation tool for full dome environment. Here are the details of this tool.
Screen Surface Coordinates

In usual implementation, objects are placed in an orthogonal coordinate system, so their spatial positions are represented as x, y and z values. But for presentation use, most objects such as images, movies and texts should be facing the audience. So in Quadratura, I adopt a `screen surface + depth coordinates system` to represent objects' positions. It allows intuitive drag and drop object placement like in PowerPoint. Better still, with this coordinate system one can use the same contents both on flat screens and dome screens by simply changing the base coordinate system according to the new screen shape. All objects are actually placed in 3D space, so it supports stereoscopic rendering too.
During interactive presentations, the speaker will be able to put additional objects at anytime and anywhere he or she wants. To get the most out of the immersive environment, the speaker should check the entire view of the presentation space and be able to layout the objects in this view.

In Quadratura, changing the view style of the operation console can be done at anytime. It has 3 view styles: First Person View, 3rd Person View and Dome Master View. With these views, one can quickly grasp the entire layout of objects and arrange them intuitively.
Object Types

In Quadratura, you can add objects just by dragging and dropping the files from the explorer windows onto the 3D screen surface in the console window. Currently supported object types are: Images (with alpha, most of common formats and sequential images), Movies (with alpha, most of common formats), FITS files (real-time exposure processing supported), 3D models, Texts and All-sky Images / Movies (with alpha, Dome Master, Panorama and Cubic Files format supported).

All these types of objects can be placed and composited in 3D space. This making the tool useful, not only for interactive presentation, but also for the pre-visualization of the full-dome movie contents. I found that composition of all-sky movies with alpha channel allows for powerful full-dome special effects.

Further more Quadratura SDK can extend these supported object types easily. Currently, I have plans to develop some additional object types such as: Real-time particles, Web browser, Video chat and 3D avatar characters.
Presentation Assistance

Once the objects are placed around the presentation space, you can store the current objects and layout as a ‘Slide’. Notice that in this tool, a slide does not mean a 2D image but a whole 3D scene environment. An entire presentation can be done by showing slides sequentially. For accessing a specific slide, you can select the slide from the console window or directly from the on-screen slide launcher.

To assist the presentation, Quadratura also has various transition effects for each object (implemented by shader language and extendable by the user). Virtual 3D cursors and free drawing pens are quite useful for marking up the important points. These cursors and pens can move across the entire area of the screen surface projected by different PCs.

Script Control

All operations in Quadratura are implemented as internal script commands. So you can record your interactive presentation into a script file, and replay it later. This replay capability allows the rendering of the entire presentation as a Dome Master movie. You can also make useful macros for your interactive presentations.

Projection Correction

If you have an optical planetarium facility, you can project the Quadratura scene over the starry scene with as many projectors as you want. This tool comes with integrated real-time slicing functionalities (distortion correction and edge blending), so you can fill the displayed area as large as you want. These projection corrections are designed not only for domes but for any screen shapes, so you can use this presentation tool for any kind of immersive theatres. With this real-time slicing functionality, you can drag and distort the displayed image directly. It is extremely useful for quick projector adjustments.
Embed in Applications

The last and most important feature of Quadratura is that it is also an embeddable 3D library for OpenGL-based real-time applications. I integrated it in Mitaka Pro, a real-time space simulator which originally developed by the 4D2U Project, to make it full-featured astronomy presentation software. Quadratura works as an overlay plane of the space scene, and shares the projection correction and setup of the base application Mitaka Pro.

Integration of Quadratura to such kind of interactive contents gives great usability to it. In the next step I’ll integrate Quadratura with Uniview, and try to work with other visualization software.

Conclusion

For Synra Stereoscopic Dome Theatre, I have developed a full-dome movie real-time previewing / conversion tool AllSky- Viewer and unique interactive presentation tool Quadratura. I found that these tools make dome environments much easier to use, and extend their capabilities.

The Synra dome theatre will open this late summer. Please come and see what happens there, and let’s discuss about the future of dome media.
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References