Some Thoughts From an Artist on Fulldome Theaters

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Abstract: The medium of fulldome projection is in its infancy, but the means are fairly easily available to produce original content. As more content appears, the astronomy community will be but one beneficiary of this effort. The skill sets required to provide content for a fulldome facility are production rather than academic in nature.

The planetarium as a simulation of the night sky will always fulfill an important role in astronomy education. The many smaller facilities doing this job are preserving awareness of the night sky as a window to the universe for millions of people who live under the lights of cities. There will always be small but tightly focused planetarium facilities that perform their tasks using minimal but effective means, with the aid of live lecturers who at their best can impress young minds, as well as the most expensive visual effects, but who do little if any original show production of their own.

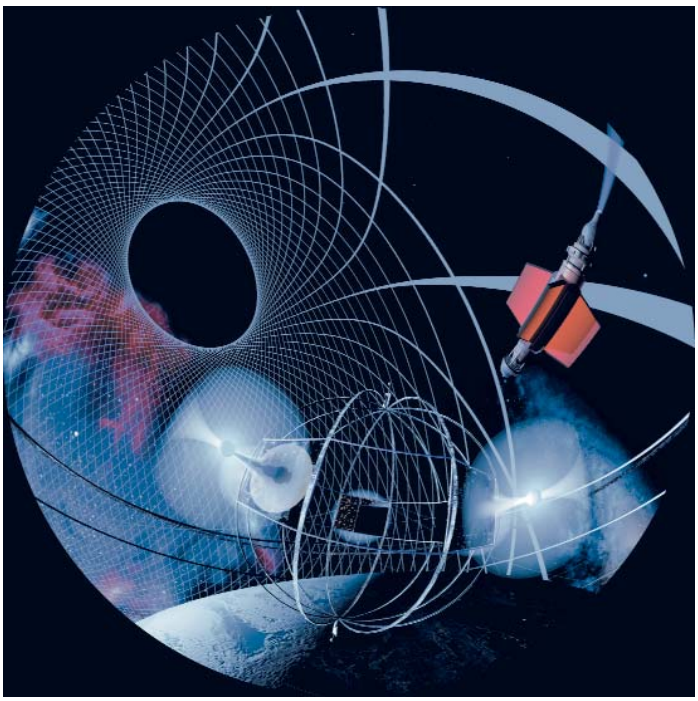
There are other facilities with more than one staff member and a little work space with possibilities for some level of show production. Large domes in government and commercial facilities are at the top of this "spectrum" of capability, recently enriched by the explosion of fulldome moving image projection. Fulldome projection is inviting the conceptual transformation of the high end "planetarium" to the general purpose "domed theater." As time passes less will be written about the machinery involved and more about the innovative productions being shown.

Emergence of Fulldome

The first public showing of a wraparound projected panorama was at the Paris World's Fair of 1900, where audiences suspended in a balloon gondola were shown a simulated flight projected around them with overlapping motion picture projections made with similarly oriented flown cameras. The 1964 New York World's Fair included a dome projection film, made by Graphic Films in Los Angeles, *To The Moon and Beyond*. This film greatly impressed Stanley Kubrick during the conceptual stages of *2001-A Space Odyssey*.

The planetarium and film were first combined in quantity by O. Richard Norton, who in the late 1960s carried 35mm film cameras with fisheye lenses on cars winding through city overpasses, perched on desert cliffs, and on white-water rafting trips. The resulting projections were enthralling, an intriguing Camera Obscura-like preview of the possibilities awaiting fulldome projection. Since then a very few 70mm Omnimax dome projection films were made (in true fisheye format); however the expense of large format film caused that medium to figuratively collapse of its own weight. Some 35mm fisheye productions for projection in planetarium domes continued, improved from earlier attempts but clearly pushing the capabilities of that medium to its limits (one intriguing 35mm fisheye film, *Space Shuttle, an American Adventure* has apparently suffered the fate of the original negatives being lost, although quality duplicate material apparently survives).

Film production, particularly in 70mm, is beyond the reach of all but the richest of institutions. Until the advances in affordable computer technology and video projection converged in the late 1990s, the ability to fill the dome with quality moving images was largely a dream. Production values in computer animation comparable to professional standards have now become affordable to most institutions and individuals.



Megastructures near a planet within a Dyson sphere, from the Evans & Sutherland show *Cosmic Safari*, ©Evans & Sutherland.

Changing Skill Sets

This growing opportunity for larger facilities to present to audiences visualizations of ongoing research should be a powerful incentive to utilize fulldome media to its fullest. There should be, in any science-oriented academy or institution with a fulldome facility, people eager to share the enthusiasm of their chosen subject and willing to interact with people in a visualization team. In my PBS production experience there was a system of integrating the information to be presented with the activities of the production staff. The writer of a given episode of a show, usually with a science background, would bring still and video reference materials to the effects facility and make sure the ideas to be demonstrated were understood, periodically checking the progress and reviewing preliminary material. I see small visual effects houses as a good model of the production environment for fulldome animation, although because of the computer graphic nature of the imagery the work space no longer needs to be large enough for significant model photography.

I suggest that one potential

area of attention concerning the growth of fulldome media is outdated concepts of the kind of professional backgrounds best suited to commanding such an unspecialized visual environment. Once you have a projection system that is not specific to astronomy it becomes more of a "blank canvas" for visual possibilities and inherently less of simply being a teaching device for any one field. If a given facility capable of ground-breaking production does no more than pretend to be a traditional planetarium, it seems wasteful of the possibilities. Surely among the necessary and inspirational roles of the traditional planetarium, other areas of exploration of this open ended visual environment warrant attention.

The director of a fulldome facility should be open-minded to running a theater as well as a classroom. I believe a director actually involved in production need not be hired solely on academic credentials such as are routinely listed in job descriptions. A planetarium director in larger facilities was traditionally at or near the helm of the show production process, and of course was well-educated in the relevant aspects of the phenomena to be simulated. In recent decades some facilities now divide the duties involved in running things, with an administrative director working with a creative director who actually creates the shows. Whoever actually determines what is shown in the dome can either act as a facilitator or a bottleneck for production-capable facilities, depending on how the potentials versus the possibilities are matched.

If paying audiences are sought, they must be shown things which will generate significant word-of-mouth publicity. A creative director is more likely to succeed in the role of creating such visualizations if they came from a production environment, acquiring relevant knowledge in the process of the job than when an academically-based individual attempts to learn the arts of visual effects and movie directing. Providing paying audiences with an experience they will recommend to others requires a very intensive effort to create visual experiences backed by all the expertise applicable to this medium.

Fulldome Production Issues

IMAX productions can be regarded as both a historical parallel with the visual environment provided by dome projection and as a warning. As fulldome media progresses it should not be allowed to turn into another IMAX in its dominance of "grand but bland" content. The sheer expense of shooting large format film made experimentation prohibitive. Many fine helicopter shots of terrain are shown, but most such films are generally dull narrated travelogues, as if the medium is simply too costly to take any chances with. Let that not be the fate of fulldome theaters. The fairly limited selection of IMAX films and the near impossibility of creating films on specific topics often resulted in large-format movies drawing audiences in science centers due to the unique visual experience they provide and not necessarily the quality of their storytelling or relevance to topics dear to facility directors. Fulldome digital media is changing the trend of "ready-made" content being antithetical to teaching and telling stories of ones choice. As more material becomes available and more facilities choose to pursue even limited content creation, the many shows in circulation will serve as a kind of "stock footage: pool for many of the more modest fulldome theaters with solely "playback" capability.

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Fulldome is at present primarily a computer graphic medium. The technological challenge for designing a camera for this medium will be to capture a 4000 pixel diameter circular image format with near lossless compression at 30 frames per second. Such a camera must be able to image the Sun in the daytime sky all day without damage to the pickup device. I worry that the first fulldome cameras will be so dear that years may pass before sufficient experimentation allows the defining the new "film grammar" of immersive video. Live capture of real environments, with time lapse capability, will probably dominate the early use of such cameras. The horrors of managing in a fisheye environment scenic lighting, model setups, camera crane movements, and other considerations routinely managed in traditional cinematography promise some intriguing times ahead for future fisheye filmmakers.

Facilitating the bringing together of equipment and the filmmakers is of overriding importance for the development of this art form. As this new visual medium emerges, more and more content producers will be attracted as the growing number of theaters provides a distribution network for new works. There should be some kind of accommodation of independent animators agreed to by facilities who see the mutual benefit of attracting and providing varied fulldome content, such as percentages of the "box office" being paid to independent animation producers when their works are shown. Animated "shorts" could be a great asset to the available programming of a domed theater, reminiscent of the cartoons once routinely shown in movie theaters between features. Once experimentation has reached a certain level, the kinds of visual experiences available will overlap with and perhaps revive the audience appeal once generated by laser shows, which were quite crude compared to what can be done with immersive abstractions even now. The idea is to promote a variety of appropriate material to attract and bring back audiences treated to unique immersive experiences.

In considering the options for fulldome presentation, the visual impression made on the audience is greatly affected by the orientation of the "center of attention." Traditional horizontal dome planetaria were designed to simulate a night sky and little else, with scenery projected along the bottom of the already elevated "horizon line." This generally created a "view from an open pit" appearance to the overall view, although the quality of such projected environments could be otherwise quite high. Duplication of projected images was one way of allowing

Apollo 14 site region. © Don Davis.

the entire audience to see slides of specific subjects mentioned in the narration.

Immersive video in horizontal (non-tilted) domes is cursed by the need to "squeeze" the view to bring the surrounding horizon above the "cove line" to simulate the types of landscapes done in traditional planetaria with multiple slide projections. This results in objects of known shape such as planets being squashed on the vertical axis. Trying to compose scenes for a horizontal dome theater with concentric seating is an awkward task. In a show at the American Museum of Natural History, slowly spinning the entire view on the vertical axis was used to share scenes with different portions of the audience under their horizontal dome, but this cannot be comfortably relied upon for an entire show. Extra effort must also be made to provide comfortable neck rests on the seats if the zenith of the dome is to be made the center of the audience attention. The varieties of presentations possible are compromised when attempting to wed a fulldome theater with a traditional "flat" dome planetarium, especially one including a traditional electro-mechanical projector.

I believe tilted domes allow the best use of a hemispherical visual environment, with a tilt angle of 22.5 degrees being my preference. I create practically all of my animations, a significant portion of those now available, with this orientation, using 1/16 slice of the hemisphere to display the scenery below the horizon. Greater tilts can show more scenery below the viewer, but require more extreme theater design. Significantly lesser tilts tend to minimize the advantages of this design. Tilted domes allow a true eye-level horizon to be simulated and experienced by at least some of the audience, which does away with a level of "suspension of disbelief" traditionally imposed on audiences of horizontal domed presentations noted above. Seating which faces the lowest point of a tilted dome allows everyone to face a common center of attention for appropriate presentations, while allowing an immersive environment to be experienced without having to look up at the zenith. For cinematic approaches the usefulness of some type of "frame" within which to compose shots is an important device to have available, even as wide a frame as a tilted hemispheric view.

Pre-Rendered Versus Real-Time

Although fulldome content is and will likely continue to be primarily a medium for showing "pre-rendered" programming, the sophistication of real-time presentations will continue to grow. Real-time shows in fulldome theaters wave the banner of spontaneity; however they also shoulder the burden of operator and software-related idiosyncrasies absent from a refined pre-rendered production. Because of the need to simplify rendered scenes for real time use, their apparent visual quality tends to lag several years behind that of pre-rendered shows. In relatively simple graphics such as starfields, there is little difference between pre-rendered and real-time. In scenery and architecture-intensive shots, the complexity and detail of the simulated environments result in more apparent visual compromises. Pre-rendered material can use all the cinematic methods of carefully-crafted dramatic moves within detailed scenery, but with no excuses to offer for less-than-professional results.

The viewing experiences of participants and passive audiences tend to be divided in real-time shows. The person using the joystick acts as one using a flight simulator, while the rest of the audience sees a real-time quality animated experience with awkward camera moves. Finding a useful way for more than one audience member at a time to interact with a show is a challenging task.

Where real-time presentations truly excel is in presenting data such as models of the local universe which can be flown through and related to the skies as seen from Earth. Audience reactions and individual requests can be accommodated, and no two shows are quite alike. Here the abilities of the presenter become an important aspect of the show once again, a potential strength that small planetaria have enjoyed to this day. As datasets in the Earth sciences, biology, and other sciences suited to visual presentation are prepared, the opportunities to present the developing knowledge in these fields will multiply.

The Future

The range of subjects which will fill domes will soon transcend those traditionally emphasized in domed theaters run as astronomy classrooms. Astronomy will be but one floating scrap in a flood of visual instruction and entertainment to come. As fulldome media comes of age directors will arise, working out ways to tell stories suited to the possibilities of the medium. It is my hope that the development of domed theaters will be seen as a worthy medium for dramatic and esthetic presentation by the heads of such facilities as well as by "filmmakers" and, of course, paying audiences. ☆