Spherical Video for Simulation

Gordon Harris

ABSTRACT

HMD's have resolution, comfort and hygiene challenges for multi-user training. But they are very immersive and allow complete 360 degree look-around ability. Computer-generation of complex environments like ships for training purposes can be realistic but require weeks of modeling time. Our concept was to explore fast capture of real-world scenes using *spherical video capture* with multi-camera rigs to reduce capture time to hours. We combined this with ellipsoidal multi-projection using cost-effective laser phosphor illumination and GPU warping to overcome some HMD problems. Our SV1 concept prototype shown at IITSEC2015 was the result.

This experiment demonstrated that an immersive virtual walkthrough could be achieved using 2D equirectangular stills. We did this by texture mapping images into a 3D array of spheres that mirrored the ships physical layout. Viewpoint transition between spheres replicated a natural segue between image eye points and supported the "3D sensation using 2D content" experimental intent. Content comparisons revealed that source content resolution should be at least double the display resolution to ensure content is not the acuity-limiting factor. High fidelity end-content helped support immersion by allowing the viewer to focus on the intent of the content with multi-planar sound.

We prototyped two applications in the Virtual Reality Toolkit: Vizard. Development took a modular style, with common elements shared. A common display module defined asymmetric frustums to render a seamless view to the display: single-GPU running four channels as an extended desktop. We required a single-GPU configuration given the need for unified video decode and playback across four channels. Performance was not texture-fill limited, rather video decode limited. A common control module defined pan/tilt navigation with a 3DConnexion SpaceNavigator device. The video tour application consisted of a simple player, while the photo tour application included annotations and user-driven navigation.

Christie's TwistLT and AutoCal software and camera controlled warping and blending in the NVIDIA GPU with NVAPI. The system was setup as a 2x2 in Mosaic mode, to facilitate content generation via Vizard. The individual outputs of the system were finally calibrated as separate outputs using standard frustum based viewports. One challenge faced when designing the system was that the actual FOV didn't feel immersive enough initially. To overcome this, a virtual design eye point was used to allow the content to be iteratively rendered closer to increase the effective field of view of the content. This resulted in some distortion, but did offer a better user experience.

To maintain high resolution throughout the viewing sphere, a multi camera array was used to generate Equirectangular (stitched) images of 12,000 by 6,000 pixels. This ultra-high resolution image was then mapped to the four projector array, resulting in high definition throughout the entire sphere. While one scenario was based on still images, we showed two other examples of lower resolution 4K video using spherical video capture and playback. Based on the immersive and highly realistic quality of these images, they can be incorporated in many applications for training and simulation in lieu of costly 3D modeling and animation techniques.

BIO

GORD HARRIS, R&D Program Manager – Vis Sim

Gord Harris works in R&D as a physicist for Christie on simulation and visualization displays. Recent work includes concept & design of SV1 simulator, Deployable Immersive Simulator, DualView display, EGG 3D system and Collimated 3D display – all forms of immersive displays. Previously he worked as freelance R&D consultant for four years after 24 years at IMAX as an engineering generalist in the science of mechanical, optical and electronic display systems. Harris joined IMAX Corporation in 1977 after receiving degrees in Physics & Film Production to found the IMAX Camera department and ultimately design and build over twenty camera systems from high speed to undersea and space. Later as Manager of Engineering, then R&D, he and his team developed new R&D technologies such as IMAX *Solido* 3D LC glasses & projection system for Expo 90, the SANDDE stereo animation system and 3D cameras. The IMAX Solido 3D camera/projector/dome/glasses system was given the Century Achievement award for historical achievement in Stereoscopic 3D from the International 3D Society in Oct 2010.