DISPLAY SOLUTIONS

Unique Solutions for Unique Problems

THE SHAPE OF THINGS TO COME

In the past few years, solid-state video projectors have become the predominant choice for large screen visual system displays, replacing CRT based video projectors in all but a few applications. The solid state projectors (LCD, DLP, LCOS) outperform the CRT projectors in almost every area with the exception of "black level" and display of very small, intense "light points". One other major difference encountered when using the new solid-state projectors is in their "fixed format" pixel configuration. While typically not a big problem for flat screen applications, the digital projectors do not easily lend themselves to changing the "shape" of the projected image, as is required when projecting images onto the curved screens used in most multi-channel simulation theaters. CRT based projectors accomplish this by modifying the analog based beam deflection in the CRT to pre-distort the image on the face of the CRT.

This requirement has been addressed by the introduction of image warping preprocessors that map the rectilinear image source into a pre-distorted form that compensates for the optical distortion created by projecting onto a curved screen surface. The resultant projected image is then displayed in the desired shape on the screen. There are a number of signal processors on the market to choose from, with some of them being "integrated" into the projector itself, while others are available as external third party processors. The external processors generally have expanded capabilities relative to the integrated processors that have more limited space and power and are exposed to a higher thermal environment. Integrated warp processors also need to be "repurchased" whenever a projector is replaced due to failure, damage or upgrade. Not surprisingly, projector manufacturers typically offer the integrated processors. There are some significant differences in how the image warping is implemented between the various products that should be considered. There are also numerous other features and functions that are included in some of the processors that may be important in the evaluation and selection process.

IMAGE WARPING

The primary function of the "warping" engine is to create pre-distorted image geometry to compensate for the optical distortion created by projecting onto a curved projection surface. One of the principal differences among the available products is the interactive nature of the graphical user interface (GUI). Some warpers work in "real time" allowing the user to "drag" actual image points in real time. Other warpers generate an internal dot test pattern and the dots get "dragged" in what appears to be real time to match up to markers located on the projection screen. This modified dot pattern is then used to generate a warp algorithm that is used to process the actual video signal. Both methods result in a correctly shaped image, with the principal difference occurring in the matching of adjacent images. In the real time systems, final adjacent image matching can be done by dragging image points while viewing the actual displayed pictures. In the non-real time systems, the actual pictures must be examined for mismatches and then the user must revert back to the test pattern and make estimated adjustments. This requires an iterative process to get the best match.

Other differences include the number of "control points" available for fine adjustment, ability to do "control point group" adjustments such as keystone correction and ability to do "automatic" geometry correction.

COLOR BALANCE

In addition to geometry warping, the ability to manipulate intensities of the R, G and B input video signals is crucial to matching the colors of adjacent images in multi-channel and/or edge-blended theater configurations. Most projectors have some degree of adjustment (brightness, contrast) integrated into the projector design, however good color matching between adjacent images typically requires more adjustment range and more adjustment "handles" then is usually available in the projector. In addition to individual RGB gain (contrast) controls, RGB "offset" (brightness) controls and RGB gamma (linearity) controls are also useful for color image matching. Again, the GUI that provides for these adjustments can be critical to making the best match. "Slider" controls that make changes to the actual image in real time allow the adjustments to be made smoothly and in small increments w/o taking the technicians eye off of the image. RG&B "switches" that can project individual color components of the final image one at a time are also quite useful (and not always available).

Finally, the availability of S/W and H/W "hooks" into the processor for interfacing commercially available colorimeters can speed up the process and improve the accuracy of the image color match for the entire system.

EDGE BLEND

When a panoramic image is projected using multiple images tiled and overlapped to create a large composite image, the overlapped regions of the images must be "feathered" in intensity to eliminate the "double brightness" effect in the overlapped region. Most warp processors have this feature included in the toolset. The ability (and ease) of adjusting the boundaries of the feathering region of the images, including the shape of the feathered region is crucial to creating a good blend zone. The ability to have multiple control points for defining the overlap region of the image is very useful, particularly when projecting on spherical surfaces. Another feature to look for is the ability to adjust the "shape" of the feathering function to create the smoothest (not visible) blend.

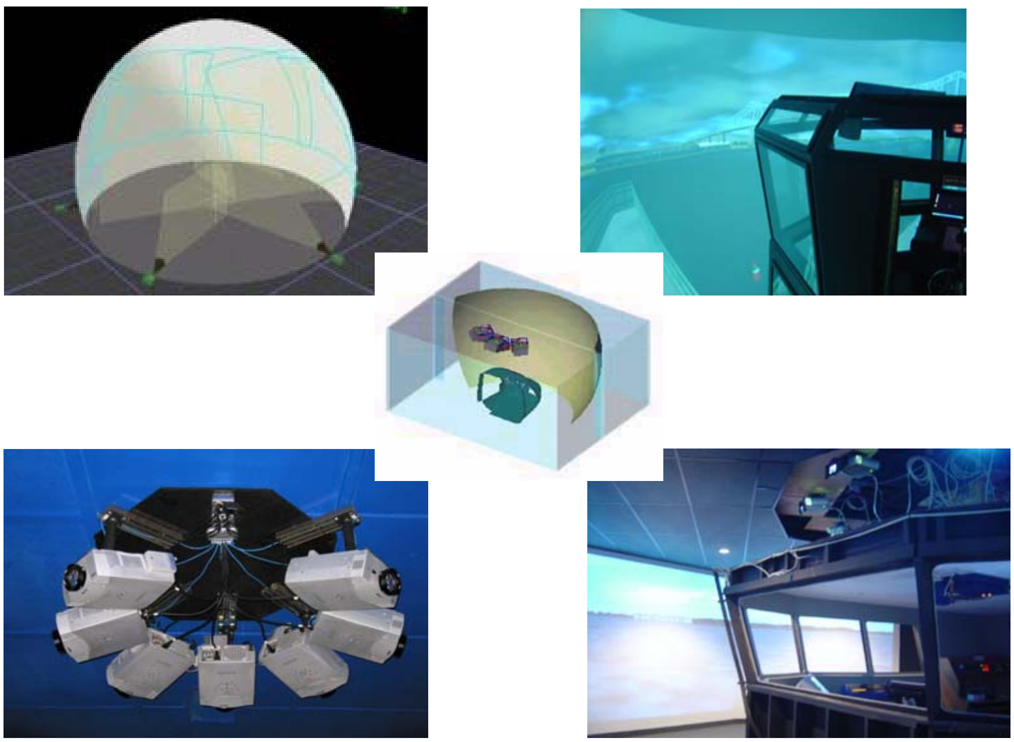
SPATIAL INTENSITY MODULATION

The adjustments for color matching mentioned above operate on the entire image. There are also image adjustments that work on independent areas of a single image that can be quite useful for creating good multi-image tiled displays. Optically projected images exhibit "hot-spotting", where the edges of the image appear dimmer than the center of the image. This is an inherent effect of the physical optics of projection lenses. Lenses can be designed to minimize this effect, but can't be designed to completely eliminate it; at least not w/o considerable cost impact. With reasonably practical optics, this effect is generally not objectionable on single images, but when viewing multiple, tiled images the effect will be very noticeable as bands of brightness intensity across the composite image. Some warp engines include the ability to modulate the contrast across the image plane to attenuate the brightness at the center of the image relative to the edges, thereby eliminating the hot spot.

LCD projectors typically have a slight red-blue shift across the horizontal axis of the projected image. This is a result of the light rays passing thru the red & blue LCD panels intersecting the panels at different angles from one edge of the panel to the other. This angular variation causes a slight change in the modulation transfer function of the panels. The net result is slightly higher transmission (or attenuation) between one edge of the image to the other. The effect is most noticeable on white or flat tiled (edge blended) color fields since the predominant red edge of one image is adjacent to the predominant blue edge of the next image. This can make color matching at the seams very difficult, if not impossible. The ability to modulate the red and blue intensity across the horizontal axis of the image can eliminate this problem.

SUMMARY

Creating a multi-image, edge-blended projection display can provide an impressive wide screen visual image for many applications. The development of new solid-state projection displays has enhanced the performance potential of these visual systems. The up front installed cost, as well as the long-term life cycle costs of the systems has also been reduced. While it is fairly straight forward to set up a multi-channel edge blended display, achieving the optimum results can be a challenge. Investing in the proper equipment and utilizing the services of experienced visual system service providers can pay back with shorter time to completion and significantly improved results in the final image quality.



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