

Shadow Elimination and Occluder Light Suppression for Multi-Projector Displays

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Summary

We demonstrate a new application for camera-projector systems where multiple front projectors are used to generate redundant illumination over the display surface. A multi-projector display with shadow elimination could provide a good alternative to expensive rear-projection systems that require specialized projection surfaces and space behind the screen for projectors. The projectors are placed at extreme angles but oriented so that their projection areas overlap significantly. By appropriately pre-warping the images sent to each projector, the system generates a sharp, keystone-corrected image in the overlap zone. Redundant illumination makes the display resistant to occlusions: the content in a partially-occluded region is readable as long as one projector maintains an unblocked light path. Unfortunately, the occlusion still causes a shadow in that region (visible as a darker patch). We demonstrate a system that automatically detects and dynamically eliminates these shadows so that the display surface appears shadow-free even in the presence of multiple, moving occluders. The system dynamically identifies occlusions using cameras, and eliminates shadows by appropriately adjusting the images projected by each projector. Rather than locating occluders by tracking objects in the environment, our approach focuses exclusively on detecting artifacts on the display surface. Shadows are eliminated using a feedback loop that requires no explicit photometric models of the environment. No assumptions are made about the locations, sizes or shapes of occluders. Details are given in the accompanying CVPR paper [1].

We also demonstrate a newer (unpublished) system that simultaneously solves a second problem: suppressing the blinding light that is projected upon users when they walk between a projector and the display surface. As in the earlier system, the occluder is not visible in the camera's field of view, and its position is inferred indirectly from the shadows created on the display surface.



Figure 1: Top left: single projector display; Top right: multi projector display (no shadow elimination); Bottom left: shadow elimination system (from [1]); Bottom right: shadow elimination with occluder light suppression. In the final system, very little light falls on the user's face.

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References

- [1] R. Sukthankar, T.-J. Cham, and G. Sukthankar. Dynamic shadow elimination for multi-projector displays. In *Proceedings of Computer Vision and Pattern Recognition*, 2001.