Multiperspective Modeling, Rendering, and Imaging

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A perspective image represents the spatial relationships of objects in a scene as they would appear from a single viewpoint. In contrast, a multiperspective image combines what is seen from several viewpoints into a single image. Despite their incongruity of view, effective multiperspective images are able to preserve spatial coherence and can depict, within a single context, details of a scene that are simultaneously inaccessible from a single view, yet easily interpretable by a viewer. In computer vision, multiperspective images have been used for analyzing structure revealed via motion and generating panoramic images with a wide field-of-view using mirrors. In this STAR, we provide a practical guide on topics in multiperspective modeling and rendering methods and multiperspective imaging systems.

Many ideas in this report are relatively new to digital artists and graphics and vision researchers and there is no up-to-date reference text. Many techniques discussed here combine methods from computer graphics, computer vision, and computational photography, and therefore, involve a steep learning curve. For example, computer graphics researchers usually render multiperspective images on an ad-hoc basis without understanding the underlying camera geometry, while computer vision researchers face difficulty in using the multiperspective geometry for designing useful imaging systems. The goal of this STAR is to present both aspects in a compact form.

We start with a brief review of multiperspective image techniques frequently employed by artists such as the visual paradoxes of Escher, the Cubism of Picasso and Braque, and multiperspective panoramas in cel-animations.
We then provide a practical guide to existing multiperspective camera models, with an emphasis on their underlying geometry and image properties. We demonstrate how to use these camera models for creating specific multiperspective rendering effects. Furthermore, we show that many of these cameras satisfy the multiperspective stereo constraints and we demonstrate several multiperspective imaging systems for extracting 3D geometry for computer vision.

The participants learn about topics in multiperspective modeling and rendering for generating compelling pictures for computer graphics and in multiperspective imaging for extracting 3D geometry for computer vision. We hope to provide enough fundamentals to satisfy the technical specialist without intimidating curious digital artists interested in multiperspective images.

The intended audience includes digital artists, photographers, and computer graphics and computer vision researchers using or building multiperspective cameras. They will learn about multiperspective modeling and rendering, along with many real world multiperspective imaging systems.