Abstract. During movie production, movie directors use previsualization tools to convey the movie visuals as they see them in their minds eye. Traditional methods of previsualization include hand-drawn sketches, storyboards and still photographs. Recently, video game engines have been used for previsualization so that once the movie set is modeled, scene lighting, geometry, textures and various scene elements can be changed interactively and the effects of many potential changes can be previewed quickly. The use of video games for previsualization involves manually modeling the movie set by artists to create a digital version, which is expensive. We envision that a computational photography camera can be used for capturing images of a physical set from which a model of the scene can be automatically generated. A wide range of possible changes can be explored interactively and previewed on-set including scene geometry and textures. Since our vision is large, we focus initially on an initial prototype (a computational photography camera and previsualization algorithms), which enable scene lighting to be captured, inferred, manipulated and new lights applied (relighting). Evaluations of our light previsualization prototype shows low photometric error rates and encouraging feedback from experts.

1 Introduction

Movie making is the process of storytelling using creative visuals and audio scenes. While designing the movie set, its physical configuration must be matched to the director’s artistic vision. Previsualization techniques are used to create approximate previews of a movie sequence prior to shooting it. Often these techniques are used to convey the artistic direction of the story in terms of cinematic elements, such as camera movement, angle, lighting, dialogue, and character motion. Essentially, a movie director uses previsualization (previs) to convey movie visuals as he sees them in his "minds-eye". Traditional methods for previs include hand-drawn sketches, storyboards and photographs to convey how a scene or character might look or move.

A recent trend has emerged whereby 3D video game engines are used to design movie sets and perform previsualization (called 3D previsualization). By understanding the effects of the various options available to the filmmakers prior to shooting, previsualization can help to minimize reshoots, save time, money, and facilitate the creative process [1]. Digital previsualization platforms have the advantage that once a scene is digitally modeled, visualizing changes to the scene can be done interactively and the effects of many potential changes can be previewed quickly. However, using
video games for previsualization involves manually modeling the movie set by artists to create a digital version, which is expensive. Consequently, digital platforms for previsualization are currently used mostly by big movie companies.

**Our Vision.** Computational photography cameras and algorithms have recently emerged [2]. We envision that a computational photography camera (hardware, algorithms and software) can be used for interactive 3D previsualization. A digital model of movie set can be automatically generated from a picture (or pictures). Various scene configurations can be explored by the director including lighting choices, movie furniture, props and object materials in order to guide on-set design choices.

![Properties Editor](image1.png) ![Idealized Previs Interface](image2.png)

**Fig. 1.** Our envisioned previsualization interface that facilitates the virtual capture and edit all of a movie scene’s properties including geometry, object reflectance, texture, shadows and lights

Figure 1 is a mock-up of our envisioned previsualization interface. Using our computational previsualization camera (hardware, algorithms and software), a movie set is digitized in real time to capture scene objects, material, lighting and textures, which can be edited on-set by the movie director to view the effect of changes. In the figure, a scene object has been selected by the user via the interface (red dotted line). The interface then provides all the options for editing the real object virtually such as textures, reflectance, geometry, and lighting changes and previewing the changes in real-time. This tool would provide the same level of control for visualization as 3D modeling tools such as Maya or 3D Studio max on-camera.

**Our Initial Scope.** Our vision is extremely large encompassing the capture, manipulation and previsualization of almost all scene elements including lighting, shadows, texture, materials and geometry. As a proof of concept, and to manage the scope of our efforts initially, we focus on capture, analysis, manipulation and previsualization of lighting modifications on the movie set independent of the other scene properties. Scene lighting has a dramatic effect on the artistic aspects of the scene by evoking mood, directing attention to specific details, and allowing the director to convey thoughts and ideas. Figure 2 shows several examples of the use of cinematic lighting; We automatically capture the on-set lighting and provide interactive manipulation of