Lightfield Media Production System using Sparse Angular Sampling

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Figure 1: *Virtual stereo pair with user-adjustable inter-axial distance (left), synthetic aperture renderings (center, right)*

1 Introduction

Traditional film and broadcast cameras capture the scene from a single view point or in the case of 3D cameras from two slightly shifted viewpoints. Important creative parameters such as the camera position and orientation, the depth of field, and the amount of 3D parallax are burned into the footage during acquisition. To realize artistic effects such as the matrix- or the vertigo-effect, complex equipment and very skilled personnel is required. Within the former effect the scene itself appears frozen, while a camera movement is simulated by placing dozens of cameras in a mainly horizontal arrangement. The latter, however, requires physical movement of the camera which is usually mounted on a dolly and translates towards and backwards from the scene while the zoom (and focus) are changed accordingly. Beside the demanding requisites towards equipment and personnel, the resulting effects can usually not be changed in post-production. In contrast lightfield acquisition techniques allow for changing the mentioned parameters in post-production. Traditionally, in absence of a geometric model of the scene, a dense sampling of the lightfield is required. This can be achieved using large cameras arrays as used by [Wilburn et al. 2005] or hand-held plenoptic cameras as proposed by [Ng et al. 2005]. While the former approach is complex in calibration and operation due to the huge number of cameras, the latter suffers from a low resolution per view, as the total resolution of the imaging sensor needs to be shared between all sub-images captured by the individual micro-lenses.

2 Our Approach

We present a system which allows capturing the lightfield of a scene using a 2D array of high definition cameras. By using disparity estimation techniques, we create implicit geometric information of the scene without requiring additional depth sensors. Subsequently, we convert the original lightfield with sparse angular sampling into a dense lightfield by means of Depth Image Based Rendering [Kauff et al. 2007]. Once a dense set of intermediate views has been generated, we can apply traditional lightfield rendering techniques which are suitable for real-time, or near-realtime execution. This offers the full creative leeway of changing camera paths, orientation and focal planes within a user-interactive environment as shown in Figure 1. The image data is therefore ingested into a traditional post-production chain which is enhanced by a suitable set of plug-ins

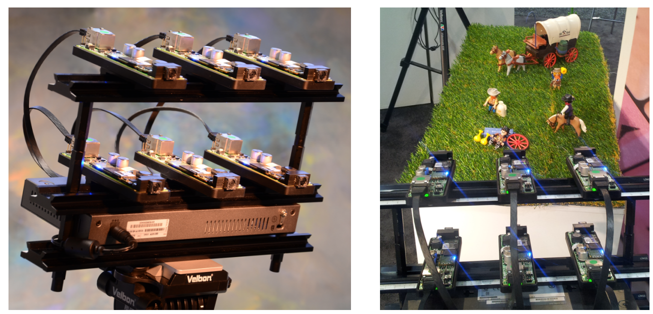

Figure 2: *Compact camera array used for recording a sparse light-field data set*

to control artistic effects such as the matrix-effect or the vertigo-effect. Our approach involves a compact camera array as shown in Figure 2 with a small number of smart-phone camera modules with a resolution of 2048x1536 pixels which can easily be mounted on off-the shelf tripods. A single ethernet cable per camera is used for data acquisition, power supply, and triggering which reduces the complexity of the setup. First results generated using the proposed lighfield media production system which are shown in Figure 1 and the supplementary video, encourage us to pursue the chosen approach within future work.

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