An Integrated Hole-Filling Algorithm for View Synthesis

Wenxin Yu, Weichen Wang, Zhengyan Guo, and Satoshi Goto

Graduate school of Information, Production and Systems,
Waseda University, Fukuoka, 808-0135 Japan
{yuwenxin,wangweichen}@fuji.waseda.jp,
ocean.milo@ruri.waseda.jp,
goto@waseda.jp

Abstract. Multi-view video can provide users a 3-D and virtual reality perception by its multiple viewing angles. In recent years, the depth image-based rendering (DIBR) is generally used to synthesize virtual view images in free viewpoint television (FTV) and three-dimensional (3-D) video. In order to conceal the zero-region more accurately and improve the quality of virtual view synthesized frame, an integrated Hole-filling Algorithm for View Synthesis is proposed in this paper. It contains five parts: the different regions distinguishing algorithm, foreground and background boundary detection, the texture image isophotes detection, the textural and structural isophotes prediction algorithm, the in-painting algorithm with gradient priority order. Based on the texture isophotes prediction with geometrical principle and the in-painting algorithm with gradient priority order, the boundary information of the foreground is much clearer and the texture information in the zero-region can be concealed much more accurately than the previous work. The vision quality mainly depends on the distortion of the structural information. Through the experimental results, the proposed algorithm not only improves the objective quality of the virtual image, but also improves the subjective quality of the virtual image a lot, and the human vision quality is also improved obviously based on the subjective results. Especially, it ensures the boundary contours of the foreground objects and the textural and the structural information.

Keywords: DIBR, Virtual view, Hole-filling, In-painting.

1 Introduction

In recent years, the 3-D products become more and more popular in people's daily life. In most traditional three-dimensional multi-media systems, only one pre-determined viewpoint of the images and the videos can be sawn by the observers. If the viewpoint is changed, the realistic 3-D impression will became much weaker and the quality of the 3-D video will be worse. In order to increase the viewpoints for the observers and make the sight more comfortable, the free viewpoint television (FTV) [1] [2] [3] is introduced. The interest in free viewpoint television is constantly increasing in recent years. Auto-stereoscopic displays provide a 3-D impression to an observer without the need to wear additional glasses [4], and the observers can enjoy the realistic 3-D impression in some

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different viewpoints. Such a display shows a number of slightly different views at the same time. To simultaneously deliver so many views, extremely large bandwidth is required in this kind of cases.

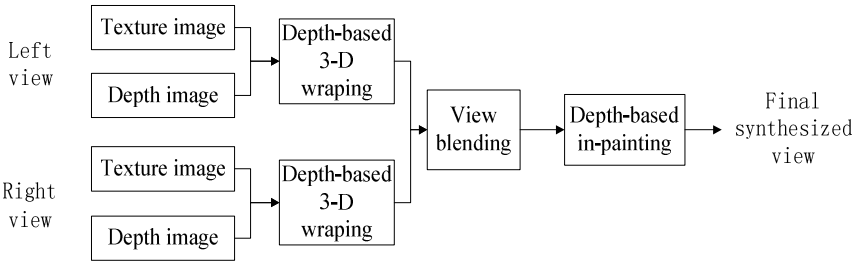

Fig. 1. Depth image-based virtual view synthesis

Therefore the view synthesis [5] is introduced to solve this kind of problems, and the depth-based virtual view synthesis process is shown in Fig.1. Depth-image-based rendering (DIBR) is a technology for synthesizing novel realistic images at a slightly different view perspective, using a textured image and its associated depth values. It is used to generate additional virtual views of a real-world scene from images or videos and associated per-pixel depth information. The 3-D warping is a key technique in the depth-image-based rendering (DIBR), and its general concept is shown in Fig.2. In 3-D warping, pixels in a reference image are back-projected to 3-D spaces, and then re-projected onto the target viewpoint. An inherent problem of the view synthesis concept is the fact that image information which is occluded in the original view may become visible in the "virtual" image. Then some holes will appear in the virtual image, and they can be also called zero-region. The information of the occluded region in the original image is lost in the virtual image and need to be concealed. Therefore the hole-filling technique is required and the in-painting is the most popular method for hole-filling problems.

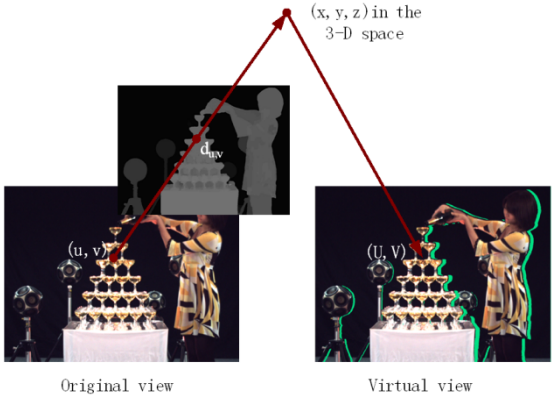

Fig. 2. General concept of 3-D warping