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FREE-VIEWPOINT VIDEO WATERMARKING BASED ON DEPTH MAP

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Abstract. *With the development of the theory of 3D video, free-viewpoint video (FVV) has become a popular research area. However, methods that protect their copyright are not very seamless. In this paper, we analyze the characteristics of the FVV and propose a novel watermarking scheme for the FVV generated by depth-image-based rendering (DIBR), which is referred to as FVV watermarking (FVW). To preserve the watermark when generating the free viewpoint video frame, we design a new strategy for selecting the optimal blocks to embed the watermark. Two criteria are considered: 1) the blocks that were selected are almost uncovered during the FVV generation and 2) the farther foreground objects are selected because pixels in these kinds of objects are more probably preserved in the FVV. To implement blind detection, we utilize the correlation coefficient method to extract the watermark. The experimental results prove that the proposed watermarking scheme can solve the watermarking problem of the free-viewpoint frame generated by DIBR without affecting the visual quality of the video.*
Keywords: Depth-image-based rendering, Free viewpoint video, Video watermarking

1. **Introduction.** In recent years, with the convergence of technologies from computer vision (CV), computer graphics (CG), and multimedia fields, one type of new media called free-viewpoint video (FVV) has attracted much attention from researchers in vision and signal processing and in the industry. In FVV systems, viewers can freely select the viewing position and angle within a visual scene, which means that there is interactive free navigation. It can be used for various services such as broadcasting, visual communication, and education.

The complete processing chain of FVV systems can be divided into the parts of acquisition/capturing, processing, scene representation, coding, transmission/storage, interactive rendering and displays. Different technologies can be used for FVV systems. The video-plus-depth representation is one of the most efficient methods, which uses multi-view videos (MVVs) and their associated per-pixel depth maps to represent the same visual scene. One or more "virtual" viewpoint videos can then be generated in real-time through the so-called depth-image-based rendering (DIBR) techniques. To capture the associated per-pixel depth information, a so-called Zcam is developed [1,2], which is an active range camera. It integrates a high-speed pulsed infrared light source into a conventional broadcast TV camera and relates the time of flight of the emitted and reflected light walls to direct the measurements of the depth of the scene [3,4].