November 22nd 2012

Mittuniversitetet
MID SWEDEN UNIVERSITY

Depth Map Upscaling for Three-Dimensional Television: The Edge-Weighted Optimization Concept

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Abstract:

With the recent comeback of three-dimensional (3D) movies to the cinemas, we have seen increasing efforts to spread its commercial success to new markets. The possibility of a 3D experience at home, such as three-dimensional television (3DTV), has generated a lot of interest in the research and standardization community.

A central issue for 3DTV is the creation and representation of 3D content. In this context, scene depth information plays a crucial part in all parts of the distribution chain from capture via transmission to the actual display on a 3D screen. Usually this depth information is transmitted in form of depth maps and is accompanied with corresponding video frames, i.e. for Depth Image Based Rendering (DIBR) view synthesis. Nonetheless there exist scenarios where the original spatial resolutions of depth maps and video frames do not match, e.g. sensor driven depth capture or asymmetric 3D video coding. A considerable amount of research has gone into ways to match these low-resolution depth maps to high resolution video frames. Many proposed solutions utilize corresponding texture information in the upscaling process, however they mostly fail to review this information for validity.

This licentiate thesis introduces a novel texture-assisted depth upscaling that addresses the lack of information validation. The Edge Weighted Optimization Concept (EWOC) uses edge information from video frames as guidance in the depth upscaling process and additionally confirms this information based on the original low resolution depth. Various guidance sources, such as different color spaces or texture pre-processing, are investigated and extensions for increased visual quality and computational performance are presented. EWOC is further applied on 3D video coding for 3DTV distribution and an alternative depth compression scheme, based depth map upscaling, is presented.

Over the course of four publications EWOC was deeply evaluated and compared to competing approaches, with the main focus consistently on the visual quality of rendered 3D views. Results show an increase in both objective and subjective visual quality to state-of-the-art depth map upscaling methods. This quality gain motivates the choice of EWOC in applications affected by low resolution depth.

In the end, sophisticated depth map upscaling, such as EWOC, will lead to easier 3D content generation and more efficient 3D video distribution. This will increase the quality of 3DTV experience and boost its commercial success.