DIGITAL HOLOGRAMS AND CONVENTIONAL 3D DISPLAYS

T. Pitkäaho[1] and T.J. Naughton[2,1]

[1]University of Oulu, RFMedia Laboratory, Finland, [2] Department of Computer Science, National University of Ireland Maynooth, Ireland

Digital holography makes it possible to record and reconstruct real world three-dimensional (3D) objects [1]. Displaying captured holograms can be implemented numerically or optoelectronically. As real 3D displays (including optoelectronic displays) are still at the development phase and used in research, numerical reconstructions of a hologram together with conventional 3D displays is a good option for displaying the 3D data.

To display digital holograms on conventional displays, some processing of the data is required. Hologram's unique property of encoded 3D information of a scene is most valuable property from the conventional display's point of view. This property makes it possible to use only one captured and processed digital hologram at the display step. One of the simplest forms of conventional displays is an anaglyph, where impression of three-dimensionality is formed by a colour coded image pair, where two images are captured from slightly different perspectives, and placed in two different colour channels (e.g. red-green) on one 2D image. When this colour coded 2D image is viewed through properly coded lenses the viewer gets an impression of 3D. Perspectives of the scene come naturally from digital holograms and different perspectives of a scene encoded in a single hologram can be reconstructed and processed to form an anaglyph image. Another glasses based conventional 3D display is Chromadepth (http://www.chromatek.com) where a 3D impression is formed by a 2D image which contains different colours at different depth planes (depth map). Other stereoscopic displays which require a depth map as an input are displays from Philips and Toshiba which require 2D image of the scene together with a depth map.

To obtain a depth map of the scene various different methods can be used [2]. One of the methods is disparity which is a position difference of the corresponding pixels in the left and right perspectives (see Fig. 1). With digital holograms this requires reconstruction from two different perspectives and a disparity calculation. Because of the common baseline in two reconstructions, corresponding pixels can be searched for horizontally only, which makes the disparity calculation more straightforward and efficient. Disparity calculation output is a disparity map as shown in figure 2.

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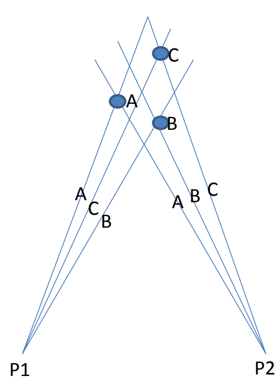

Figure 1. Disparity with holograms: P1, P2, different perspectives; A, B and C, points on the epipolar line in the reconstructed intensity image; R, reconstruction plane.

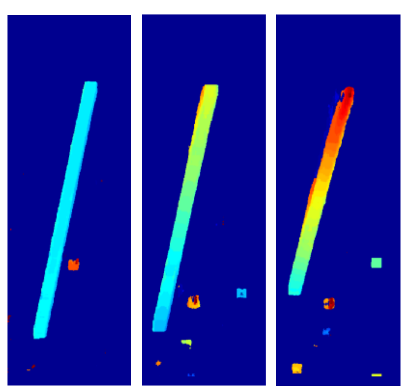

Figure 2. Disparity map (in colour) of carbon fibres on tilting glass plate, from left to right 0, 20 and 40 degrees. Reconstruction distance is 54 mm, length of the fibre is 1320 µm and diameter 7 µm.

REFERENCES

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