REAL-TIME ANALYSIS AND CORRECTION OF STEREOSCOPIC HDTV SEQUENCES

F. Zilly[1], P. Eisert[1], P. Kauff[1]

[1]Fraunhofer Institute for Telecommunications
Einsteinufer 37, 10587 Berlin, Germany
Tel.: +49 30 31002 – {611,614,615} Fax: +49 30 392 72 00
{frederik.zilly, peter.eisert, peter.kauff}@hhi.fraunhofer.de

Abstract

The Stereoscopic Analyzer (STAN) is an assistance system for the production of stereoscopic 3D. Developed by the Fraunhofer Heinrich Hertz Institute, Berlin, in cooperation with KUK Film Production, Munich, STAN combines real-time image analysis with intelligent automated tools and intuitive graphical user interfaces to assist camera operators and production staff in shooting the right stereo content for 3D postproduction and 3D live events.

Keywords: Stereo Production, 3DTV, 3D Cinema

1 Introduction

This paper discusses an integrated hardware-software solution of an assistance system for stereo shooting called Stereoscopic Analyser (STAN). A feature-based scene analysis estimates the relative pose of the two cameras in order to allow an optimal camera alignment, avoiding vertical disparities and to eliminate remaining vertical disparities through an image rectification process. In addition it detects the near- and far clipping plane of the scene, derives the optimal inter-axial distance (stereo baseline) from it and gives a framing alert if out-screen objects are clipped due to a wrongly selected convergence plane.

2 Detecting Robust Point Correspondences

The camera signals are captured using a grabber board with two single-link HD-SDI interfaces. In a first step, the luminance signal is down-sampled and the SIFT feature detector is used to find interest points and match point correspondences. The constraints of the epipolar geometry are used to filter out robust matches, to estimate the pose of the two cameras, to correct camera alignments as best as possible and to eliminate remaining vertical disparities by rectification.

3 Near- and far clipping plane detection

A histogram is calculated from the horizontal disparities of the matched point correspondences. Feature point locations might be affected by a small error, so we define the near- and far clipping plane as the 2^{nd} and 99^{th} percentile respectively. The disparity range D_{curr} is then the difference between the near- and the far clipping plane.

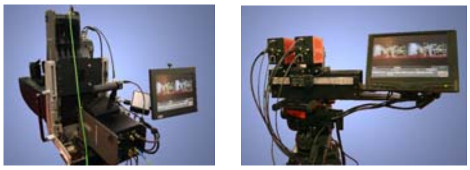

Figure 1 : Prototypes of STAN attached to two ARRI D21 (left) and two microHDTV cameras (right) shown at NAB 2009

3 Calculating the optimal Inter-axial distance

To avoid well-known accommodation-convergence-conflicts (see [1] for details), it is necessary to map the depth of a given scene into a Comfortable Viewing Range (CVR) taking full advantage of the available *depth budget* of given viewing conditions[2][3]. Thus, once the depth structure of the scene to be captured is known and targeted viewing conditions are chosen, the only degree of freedom left is the inter-axial distance. STAN exploits this relation for calculating the optimal inter-axial distance B_{opt} in function of the estimated disparity range D_{curr}, the optimal disparity range D_{opt} and the current inter-axial distance B_{curr}:

$$B_{opt} = B_{curr} D_{opt} / D_{curr} \quad (1)$$

Note that D_{opt} might be a complex function taking into account the targeted viewing conditions as well as several further production rules. In the simplest case it is the “1/30”-rule saying that the disparity range D should be 1/30 of the screen width [4]. However, we want to underline that any other framework of production rules can be defined and used by the STAN. Further details and a demonstration of the STAN will be given at the workshop.

References

[1] A. Woods, T. Docherty, and R. Koch. Image Distortions in Stereoscopic Video Systems. In *Proc. SPIE Stereoscopic Displays and Applications IV,* Vol. 1915, pages 36-47, Sept. 1993.

[2] G. Jones, D. Lee, N. Holliman, and D. Ezra. Controlling perceived depth in stereoscopic images. In *Proc. SPIE Stereoscopic Displays and Virtual Reality Systems VIII,* Vol. 4297, pages 42-53, June 2001.

[3] G. Sun and N. Holliman. Evaluating methods for controlling depth perception in stereoscopic cinematography. In *Proc. SPIE Stereoscopic Displays and Virtual Reality Systems XX*, Vol. 7237, Jan. 2009.

[4] G. Herbig. Die 3 Goldenen Regeln der Stereofotografie. *stereo journal*, Vol. 65, March 2002.