Glasses-free 3D using autostereoscopic displays in digital signage is going to become a competitive alternative to conventional 2D presentations. Several companies already provide fully integrated 3D solutions for digital signage. Content creation, however, is still a major problem. While computer-generated content can easily be converted to multiview representations required for autostereoscopic displays, content creation or conversion of live-action video still remains a challenge. Fraunhofer HHI now provides an easy-to-use Adobe After Effects plug-in solution for high-quality 3D content conversion from live-action stereo footage.

**Challenges**

Conventional glasses-based 3D displays use stereoscopic content to generate a depth impression for the viewer. In contrast, glasses-free 3D displays, so-called autostereoscopic multiview displays, require many different camera perspectives of the same scene instead of just two images to produce depth. While stereoscopic 3D content is readily available and fairly easy to produce, multiview content is still difficult to obtain.

Suitable live-action content can either be produced with a related multi-camera array or can be converted from conventional stereoscopic 3D video. Multi-camera arrays are difficult to use and the number of cameras and their inter-ocular distance are specific to the targeted multiview display. Furthermore, multi-camera rigging supporting high-quality 3D is a highly complex endeavor. Conversion of stereoscopic 3D content circumvents these problems by using conventional stereo footage as input to generate a display specific multiview representation.

Fraunhofer HHI’s well reputed stereo-to-multiview conversion already enables a high-quality conversion process using existing stereoscopic content to drive autostereoscopic multiview displays. The conversion is display agnostic. Thus, it can target many different types of autostereoscopic displays with the same stereo content. Moreover, it allows a flexible adjustment of various parameters like inter-ocular distance between adjacent views (multiview baseline) or horizontal image translation (definition of zero-parallax plane) to achieve the optimal depth impression on the targeted autostereoscopic multiview display. Now, Fraunhofer HHI has conveniently combined all this long-lasting experience in an easy-to-use Adobe After Effects plug-in suite.
Benefits

- Fully automatic or manually guided stereo-to-multiview conversion
- Conveniently available as Adobe AFX plug-in suite
- Use of existing stereoscopic 3D content to drive autostereoscopic multiview displays
- Support of 3D Digital Signage without glasses
- Future proved for new 3D multiview video formats
- Easy adjustment of depth parameters (IO, HIT, etc.) to achieve optimal 3D viewing comfort

Technical Background

To generate content for autostereoscopic multiview displays, the AFX plug-in suite of Fraunhofer HHI’s stereo-to-multiview conversion creates additional virtual camera perspectives from available stereo input. The generation of additional views is based on disparity maps estimated from the initial stereoscopic images. Disparity maps represent pixel-by-pixel information about the depth of the scene. Sophisticated confidence measures and consistency checks coupled with detection of mismatches and tricky post-filtering of disparity maps ensure robust depth calculation.

With this depth information, additional virtual camera perspectives can be generated by applying depth image-based rendering (DIBR). Thus it is possible to generate an arbitrary number of views and adapt the number and position of these virtual views to the specific properties of existing and future glasses-free 3D displays. To produce the optimal 3D viewing experience, the depth representation can be adapted individually to each autostereoscopic display under consideration. This includes the level of perceived depth by adjusting the inter-axial distance (IO) as well as the position of scene objects in relation to the screen plane by adjusting horizontal image translation (HIT). To this end, by using Fraunhofer HHI’s AFX plug-in suite it can be guaranteed that the presented 3D content is always in the comfortable viewing zone of a specific autostereoscopic 3D display.

Specifications

- Adobe After Effects plug-in suite developed for CS5 64-bit and above
- Based on long-lasting experience in stereo-to-multiview conversion by Fraunhofer HHI
- Multi-threaded implementation to take full advantages of the newest multi-core CPUs
- Compatible with both 8-bit and 16-bit S3D content
- Support for many commercially available glasses-free 3D displays like Alioscopy, Trideality, Magnetic 3D, Zero Creative, etc.
Real-Time Stereo-to-Multiview Conversion

Live Generation of content for playback on autostereoscopic displays from 3D Blu-ray

Watching 3D without glasses will be the future of 3D home entertainment. However, current stereoscopic 3D content is not suited to drive autostereoscopic displays which means that a 3D format conversion is required. Developed at the Fraunhofer Heinrich Hertz Institute, the real-time stereo-to-multiview conversion engine allows playback of 3D Blu-ray content or any other stereoscopic 3D video content on most existing autostereoscopic displays. Costly offline conversion is no longer needed and personal 3D viewing preferences can be adjusted by users on-the-fly.

Challenges

The future of 3D digital signage and home entertainment will be based on 3D display technologies without glasses. Current stereoscopic 3D, however, is not equipped for this field of application since multiple views are required to drive most autostereoscopic 3D displays.

Up to now multiview content had to be produced in a costly off-line post production process from stereo – at least if high-end applications were addressed. Such an offline process is suitable for some applications like 3D digital signage but fails in others like 3D entertainment. As most stereo 3D content is now available only on Blu-ray, an automatic real-time conversion is needed to drive autostereoscopic 3D displays in home entertainment environments.

The Fraunhofer Heinrich Hertz Institute provides a solution that creates high-quality autostereoscopic 3D in real-time suitable for most existing and future autostereoscopic 3D displays. The stereo-to-multiview conversion engine can be seen as a black box with stereoscopic 3D input such as 3D Blu-ray or any other stereo input and an output suitable to drive any autostereoscopic 3D display. The engine also is capable of adjusting various parameters to modify the depth impression in line with personal 3D viewing preferences.

Benefits

- Watching 3D without glasses from out-of-the-box 3D Blu-ray or any other 3D video content
- Real-time conversion of any stereoscopic 3D video content to multiview video representation needed for autostereoscopic 3D displays
- Support of existing and future 3D video formats for any autostereoscopic display
- On-the-fly adjustment of the depth impression according to users’ 3D viewing preferences
Technical Background

Generation of additional views from stereoscopic 3D is based on disparity maps estimated from the two input views. The disparity maps represent pixel-by-pixel information about the depth of the scene. Sophisticated confidence measures and consistency checks coupled with detection of mismatches and tricky post-filtering of disparity maps provide robust depth information. With this information, additional virtual views are generated by applying depth image-based rendering techniques (DIBR). Thus it is possible to generate an arbitrary number of views and adapt the number and position of these virtual views to the specific properties of existing and future autostereoscopic 3D displays. During this 3D format conversion, the depth impression can also be adapted to users’ 3D viewing preferences. Hence, the level of perceived depth as well as the position of scene objects in relation to the screen plane can be adjusted during conversion.

Specifications

- Highly real-time optimized core algorithms like L-HRM, SKB, STAN
- All core algorithms are designed for a maximum of parallelization
- Real-time implementation on 2 Intel Hexa-Core CPUs and Nvidia Geforce GTX 590 GPU
- Support for all commercially available autostereoscopic 3D displays like Alioscopy, Tridelity, Magnetic 3D, Zero Creative, etc.

Future Objectives

- Provision of a SystemC or VHDL implementation suitable for realization in hardware
- FPGA / ASIC implementation for set-top box or related solutions
- Further optimization of algorithms to improve image quality

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