Quarterly newsletter of the MUSCADE consortium

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MUSCADE Focus

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Special points of interest:

- The position statement is on Content Generation for Stereoscopic and Autostereoscopic Displays.
- MUSCADE researchers win IEEE Award
- EBU's 3DTV study group after one year

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Content Generation for Stereoscopic and Autostereoscopic Displays

Position Statement submitted by Frederik Zilly and Ralf Tanger of Fraunhofer HHI, Germany

Content acquisition for stereoscopic 3D has been led to maturity in the past few years. However, the underlying technology targets stereoscopic displays which require the use of dedicated 3D glasses. While this constraint is accepted in the context of 3D cinemas, a glasses-free 3D perception would be desirable in the living room. Autostereoscopic displays meet this requirement. However, for a multi-user and glasses-free 3D sensation, typically five to eight views of the scene are required. Moreover, this number of views differs from display to display. In any case, one would not want to transmit eight HD video streams to the home, due to limited bandwidth available.

It is therefore desirable to allow the generation of virtual views on the receiver side. The number of views can then be adapted to the specific autostereoscopic display which is in use. A favourable view generation technology is the depth image based rendering [1]. By transmitting a limited number of HD video streams with associated disparity maps, this goal can be achieved. This is realised by MVD2 or MVD4 where two (MVD2) or respectively four (MVD4) views are transmitted with associated disparity maps. Figure 1 illustrates this process.

The goal of the MUSCADE project is to support a wide range of 3D displays, and therefore be backwards compatible to already established stereoscopic displays. In consequence, two of the transmitted views coincide with a stereoscopic video pair which allows showing them on a stereoscopic display without view interpolation. The *Multi-Camera Rig* which is developed within the MUSCADE project reflects all these requirements. Two inner cameras inside a mirror-box capture the two views which are suitable for stereoscopic displays. Two additional satellite cameras allow for wide baseline applications.

However, the content acquisition for MVD4 is a demanding task. The *Multi-Camera Rig* needs to be calibrated with high accuracy to ensure that all cameras lie on a common baseline. This geometric constraint is necessary for an efficient camera registration process and subsequent estimation of the disparity maps. HHI is therefore de-

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Content Generation for Stereoscopic and Autostereoscopic Displays

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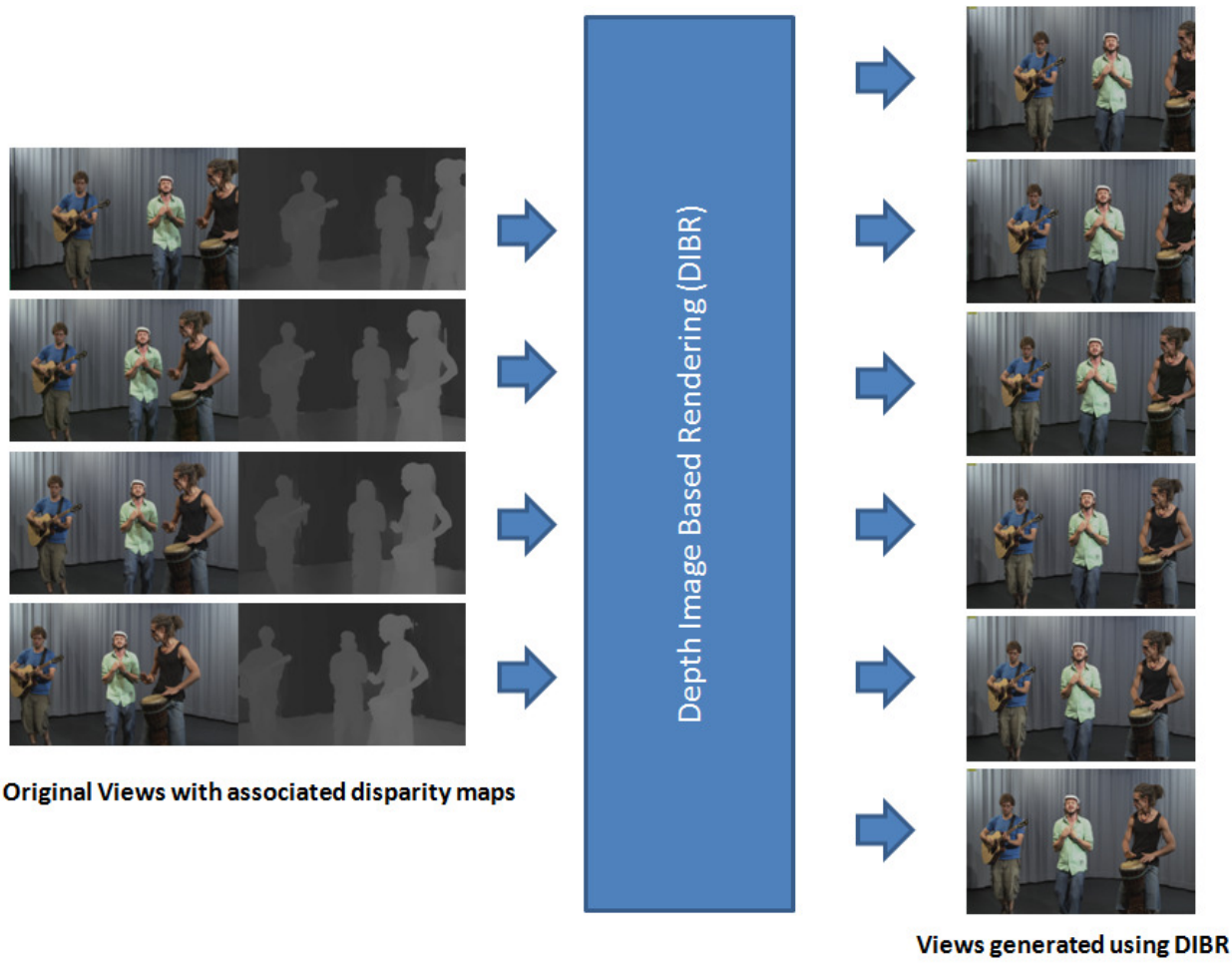

Figure 1. View generation using MVD4 and Depth Image Based Rendering (DIBR)

veloping a Multi-Camera version of its assistance system *Stereoscopic Analyser (STAN)* [2] which ensures a proper calibration of the *Multi-Camera Rig* and allows for real-time registration of the captured camera signals. Figure 2 shows a screenshot of the GUI of the assistance system.

All remaining vertical disparities are eliminated during the registration process. The video streams are now suitable for an efficient estimation of dense disparity maps. Corresponding pixels lie on the same line in the corresponding images which speeds up the search for pixel dense point correspondences. In addition, the view generation process is also greatly simplified by this geometry, as one needs to shift pixels only in horizontal direction in order to generate virtual camera positions and associated views.

By combining the technologies provided by the partners in the MUSCADE consortium, an efficient way to generate content for next generation of 3D displays is on track.

"The goal of the MUSCADE project is to support a wide range of 3D displays and therefore be backwards compatible to already established stereoscopic displays"

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Content Generation for Stereoscopic and Autostereoscopic Displays

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REFERENCES

[1] C. Fehn, "Depth-Image-Based Rendering (DIBR), Compression and Transmission for a New Approach on 3D-TV", in Proc. SPIE Stereoscopic Displays and Virtual Reality Systems XI, pp. 93-104, San Jose, CA, USA, Jan. 2004.

[2] F. Zilly, M. Müller, P. Eisert, P. Kauff, "An Image-Based Assistance Tool for Stereo Shooting and 3D Production", in Proc. International Conference on Image Processing (ICIP), pp. 4029-4032, Hong Kong, China, Sep. 2010.

Figure 2. Screenshot of the assistance system used to calibrate the Multi-Camera Rig and perform the registration of all four cameras (remaining vertical disparities are eliminated)

EBU 3DTV study group – one year after...

Link: http://tech.ebu.ch/groups/ecv_sg_3dtv

As the EBU represents Europe's public broadcasters and also works closely together with manufacturers, an EBU 3D study group was founded in April 2010. In one of the earlier newsletters this group was already presented.

Now, one year after, this group has nearly 120 members, which are interested in producing good 3D content. The aim is to find a focus point for information and experience exchange and to collect EBU member's requirements.

Some of these members are active in coming together at meetings or WebExs to create a production guideline of how to produce good 3D content by any account like technical, financial or management backgrounds on production, distribution and consumers side. Therefore, it is really important to have different points of views from each side like broadcasters, manufacturers or managers.

Because the EBU also works closely together with standards bodies like SMPTE, DVB or ITU, the EBU Technical can ensure to present user's requirements and provide MUSCADE with these experiences and knowledge about 3DTV, particularly for the requirements related tasks of the project.

Everybody, who is interested in 3DTV, is welcome to join and support this group, while also receiving necessary inputs for their respective line of activities.

"The aim is to find a focus point for information and experience exchange and to collect EBU member's requirements"

For further info, please contact: thomas@ebu.ch .

Submitted by:
EBU Technical

UNIS MUSCADE researchers won an IEEE award for their work on depth map coding

Link: http://ewh.ieee.org/soc/ces/sall.html

An object based coding approach proposed for efficient compression of depth maps won the award for the 2nd best paper of IEEE Transactions on Consumer Electronics for the year 2010. The award known as the "IEEE Chester W. Sall Memorial Award" is sponsored by the IEEE Consumer Electronics society and was awarded at the IEEE International Conference on Consumer Electronics (ICCE) held in Las Vegas, Nevada, USA, 9-12 January 2011. Dr Anil Fernando and Mr Varuna de Silva attended the ICCE to accept the award from the president of the IEEE CE Society (Figure 3).

The particular paper "Object based coding of depth maps for 3D video coding" authored by Varuna de Silva and co-authored by Dr Anil Fernando and Dr Lasith Yasakethu was published in the August 2009 issue of the IEEE Transactions on Consumer Electronics. The paper proposes an object based coding approach for depth maps in 3D video based on 3-Dimensional Motion Estimation. The particular work, conducted as a part of the Ph.D. work carried out by Varuna de Silva, is expected to have important use cases in applications that require low computational complexity. Mr de Silva is an active contributor to MUSCADE in the areas of video compression and transmission, and is working towards his Ph.D. under the principle supervision of Dr Anil Fernando. Dr Anil Fernando is the principle investigator of MUSCADE from the University of Surrey and Dr Yasakethu is now a researcher at Technicolor.

"The paper proposes an object based coding approach for depth maps in 3D video based on 3-Dimensional Motion Estimation"

Submitted by: UNIS

Figure 3. MUSCADE researchers were presented the best paper award at the ICCE 2011

Publications Corner

Improved depth map filtering for 3D-TV systems

Authors: D.V.S.X. De Silva, W.A.C. Fernando, H. Kodikara Arachchi, S.T. Worrall and A.M. Kondoz

Affiliation: UNIS

Publication: IEEE International Conference on Consumer Electronics (ICCE 2011), Las Vegas, NV, USA, 9-12 January 2011

Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5722787

Abstract:

Depth maps are used for rendering novel views in 3-Dimensional (3D) Television systems. When depth maps are compressed using existing codecs, the compression artifacts will cause undesirable distortions in the rendered views. This paper proposes an adaptive bilateral filtering technique to eliminate such artifacts at the receiver end. The experimental results demonstrate that the proposed method significantly improves the quality of rendered views up to 1.5dB, with minimal increase in complexity.

Intra mode selection method for depth maps of 3D video based on rendering distortion modelling

Authors: D.V.S.X. De Silva, W.A.C. Fernando, and S.T. Worrall

Affiliation: UNIS

Publication: IEEE Transactions on Consumer Electronics, Vol. 56, No. 4, pp. 2735-2740, November 2010

Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5681163

Abstract:

A technique to minimize distortions in synthesized virtual views, while encoding depth maps that are used in Depth Image Based Rendering (DIBR) applications is proposed. Depth maps are not viewed by end users, but are used for virtual view generation. Therefore, it is important to compress depth maps in a way that it minimizes distortion in views rendered with them. In doing so, it would be possible to generate high quality virtual views using compressed depth maps. Firstly, an error model to approximate rendering distortion caused by disparity changes is proposed. Thereafter, this error model is used at the encoding mode selection stage of coding depth maps. Experimental results illustrate an average bit rate saving of 19%-76%, compared with the mode selection method, which is based on minimizing pixel errors only of the depth map. Further, encoding depth maps with the proposed technique improves the overall visual quality of rendered views.

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Publications Corner continued...

Adaptive sharpening of depth maps for 3D-TV

Authors: D.V.S.X. De Silva, W.A.C. Fernando, H. Kodikara Arachchi, S.T. Worrall and A.M. Kondoz

Affiliation: UNIS

Publication: IET Electronics Letters, Vol. 46, No. 23, pp. 1546–1548, November 2010

Link: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5635395

Abstract:

Depth maps, which can be represented as greyscale images, are used to aid rendering of novel views in three-dimensional (3D) video systems. However, compressing them using existing video codecs, such as H.264/AVC, leads to low quality rendered views. Presented is a sharpening method based on adaptive bilateral filtering to eliminate certain artifacts observed in compressed depth maps to improve the quality of rendered views. Experimental results demonstrate that significant rendering quality improvements of up to 1.9 dB can be achieved with the proposed method.

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