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MUSCADE Focus

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**Special points of interest:**

- The position statement is on Image domain warping as an alternative to DIBR
- UNIS organizes the 2nd MUSCADE Workshop
- MUSCADE is represented at the 3DTV conference

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# Image domain warping as an alternative to DIBR

**Position Statement submitted by Aljoscha Smolic of Disney Research Zurich**

Stereoscopic 3D (S3D) has reached wide levels of adoption by consumer and professional markets. S3D cinema has become mainstream, 3DTVs and blu-ray equipment are available to consumers, S3D broadcast channels are on air, S3D cameras allow consumers to create own content, gamers can enjoy excitement in a new dimension, mobile devices are equipped with 3D displays, and so on. This current success of S3D technology is due to the fact that technology and understanding about content creation has reached a high level of maturity, ensuring a high quality user experience in most cases.

On the other hand, the necessity to wear glasses is often regarded as the main obstacle of today's mainstream 3D systems. Further, S3D systems, which are limited to 2 views cannot support all natural 3D cues, which humans evaluate to create a 3D perception. These two shortcomings of S3D are addressed by multiview autostereoscopic displays (MAD). Figure 1 illustrates the principle. They support motion parallax viewing in a limited range and do not require glasses.

However, content creation for MADs is still widely unresolved [1]. Capturing the required N views directly is impractical or even impossible due to restrictions on camera placement (see below). Therefore, the typical approach is to capture M<N views and to generate the necessary N simultaneous display views by synthesis [2] (Figure 1).

The typical disparity range that current MADs can handle is about 2 times the disparity range of S3D content [4]. This means that it is practically impossible to generate the views needed for a 9-view display as in Figure 1 by direct capture, due to physical size of cameras, even if all other problems of alignment, synchronisation, etc. of N cameras were solved efficiently. The quality of synthesised views depends among other factors on distance to available camera views and whether interpolation or extrapolation is used for view synthesis.

The most important special case in content creation for MAD is M=2, i.e. stereo input. Content creation today is dominated by stereo across all applications scenarios (cinema, 3DTV

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# Image domain warping as an alternative to DIBR

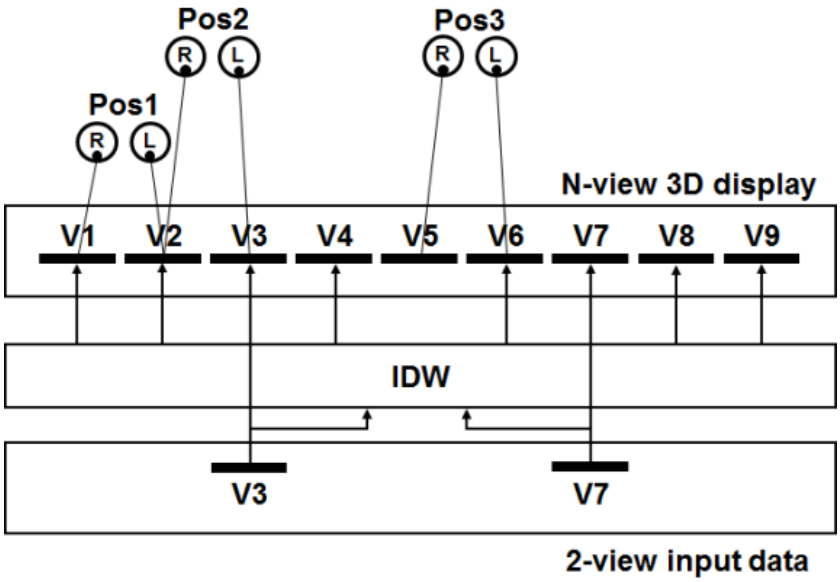


*Figure 1. Concept of multiview generation from S3D input*

broadcast, blu-ray), which will remain standard over many years. Therefore, conversion from S3D to N-view will be a basic requirement for success of MADs in the consumer markets due to backward compatibility reasons. Such a conversion has to consider different depth ranges, which are supported by glasses-based S3D displays and MADs [3]. Today's MADs typically support an overall range of double interaxial distance of typical S3D content [4].

Therefore, with S3D as input the disparity range of the content is not sufficient to create a decent depth impression on a typical N-view display. Instead, the input disparity range has to be increased by a factor of 2. This corresponds to an extrapolation of views as illustrated in Figure 1. Note, that for the example in Figure 1 the virtual distance of views 1-9 is exactly double of input 3-7.

A typical approach for M-view to N-view conversion is to use depth image based rendering (DIBR) [2]. DIBR also forms the core of a corresponding standardisation activity in MPEG [4], which correspondingly aims at efficient coding and transmission of multiview video plus depth (MVD) data to support MADs. However, this approach relies on depth estimation, which is an ill-posed and unresolved task so far. It is questionable if automatic depth estimation can be resolved with sufficient accuracy, reliability and robustness in the near future for high quality broadcast applications. So far only semi-automatic, interactive

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approaches provide the quality necessary for these envisaged applications.

On the other hand, Lang et al. [5] recently proposed non-linear disparity mapping as a powerful technology for many 3D video processing applications, including view synthesis in a limited range as necessary for S3D to mutiview conversion. This approach does not rely on dense depth/disparity estimation, but applies image domain warping (IDW) instead. It works automatically and provides high quality results.

For DIBR an extrapolation of views and virtual increase of interaxial distance by a factor of 2 poses a serious problem due to disocclusions, which can only be filled by inpainting. For IDW instead, it has been shown that such

*"It is questionable if automatic depth estimation can be resolved with sufficient accuracy, reliability and robustness in the near future for high quality broadcast applications"*

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## Image domain warping as an alternative to DIBR

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an increase of interaxial is possible at high quality [5]. Thus IDW is a very interesting alternative to DIBR and will be evaluated in more detail in the future.

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# MUSCADE at the 5th 3DTV Conference

**Link:** http://www.3dtv-con.org/3dtv-con-11/d2/

MUSCADE was represented at IEEE 3DTV-CON 2011 in Antalya, Turkey on 16-18 May 2011 by both University of Surrey and Holografika with research paper presentations. Tibor Balogh of Holografika presented one of the papers, entitled "Rendering Multi-View Plus Depth Data on Light-Field Displays", which described the parts of the work performed in the MUSCADE 3D visual renderer. This paper was authored by Alexandre Ouazan, Peter Tamas Kovacs, Tibor Balogh, and Attila Barsi.

Dr Gokce Nur of University of Surrey made the second paper presentation from MUSCADE, which was entitled "Extended VQM Model for Predicting 3D Video Quality Considering Ambient Illumination Context", and co-authored by Hemantha Kodikara Arachchi, Safak Dogan, and Ahmet Kondoz. In this paper, the standardised Video Quality Metric (VQM) model was extended to consider ambient illumination context in the video quality prediction of 3D video contents. Motion, structural feature, and luminance contrast of colour texture of 3D video contents were exploited as the content related characteristics while extending the model. The conducted quality assessments presented the efficiency of the extended VQM model to predict the video quality of 3D video under a particular ambient illumination condition.

3DTV-CON 2011 has been the 5th instalment in a series of successful conferences bringing together researchers and developers with diverse experience and activity in distinct, yet complementary, areas in relation to 3D television.

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**Submitted by:**
**UNIS and Holografika**

# The 2nd MUSCADE Workshop on 3D Multimedia in London, UK

**Link:** http://www.muscade.eu

UNIS organised the 2nd MUSCADE Workshop on 3D Multimedia in London, UK on 23-24 June 2011. During this 2-day workshop, 14 speakers from the project partners and a keynote speaker from a major broadcaster presented their vision and the results of their work related to 3D Multimedia. Meanwhile, a number of demonstrators set up also helped to show and further disseminate the accruing MUSCADE results. The event was attended by 50+ participants, who represented industry, research and academia active in 3D media both nationally and internationally. A selection of photos taken on both days is available in Figure 2.

The workshop was organised in two days to accommodate a two-part event. The first day was dedicated to presentations and discussions, while the second day was organised to hold the keynote speech and the demonstration session, which aimed to illustrate the technologies that were presented during the 1st day. The keynote was delivered by Dr Oliver Grau of BBC Research and Development, UK, and entitled, "Towards 3D Immersive + Interactive TV". This talk was very well received by the audience, and raised numerous questions and awareness for future pointers for research in the area. The detailed programme involved the following presentations and topics:

<u>On day 1</u>

- Introduction to 3D video/TV and requirements by EBU
- 3D audiovisual capturing and post productions by HHI and University of Surrey
- 3D audiovisual processing and coding by Technicolor and University of Surrey
- 3D media transmission technologies and challenges by Astrium, Telecom Italia, RAI, and University of Surrey
- 3D video display technologies by Holografika
- 3D audio reproduction technologies by Trinnov and University of Surrey
- 3D audiovisual rendering for different displays hosted by Holografika, Trinnov, and University of Surrey
- Quality of experience modelling in 3D media by University of Surrey
- Automatic content creation for multi-view video by Disney Research Zurich
- 3D AV Future by EBU and Technicolor

<u>On day 2</u>

- Keynote speech by Dr Oliver Grau, Lead Technologist, BBC R&D, UK

*" The keynote was delivered by Dr Oliver Grau of BBC Research and Development, UK, and entitled, "Towards 3D Immersive + Interactive TV". This talk was very well received by the audience, and raised numerous questions and awareness for future pointers for research in the area"*

- Demonstrations using the MUSCADE 3D content by the project partners:
  - Interactive platform by SES Astra and Disney Research Zurich
  - Multi-view camera rig by HHI and KUK Film
  - Multi-view video by Technicolor
  - HoloVizio, the glasses-free lightfield 3D display by Holografika and University of Surrey
  - 3D audio by University of Surrey

**Continued with photos of the event on page 5...**

**Submitted by: UNIS**

# The 2nd MUSCADE Workshop on 3D Multimedia in London, UK

**continued...**

*Figure 2. Scenes from the 2-day workshop, from first image to last: keynote speaker, presentations and attendees, and demonstration session*

# MUSCADE MS3 meeting on 21-22 June 2011

The MUSCADE Milestone 3 meeting took place at University of Surrey in Guildford, UK on 21-22 June 2011. Representatives from the consortium parties attended the meeting to assess the technical progress of the project. Discussions particularly focused on the necessary MUSCADE tasks to be performed in Phase II of the project work programme while also addressing several issues raised by the project reviewers during the 1st year review meeting in April 2011.

**Submitted by: UNIS**

# Announcement: *Workshop on 3D Technology and Human Factors, EBU, Geneva, Switzerland, 6-7 October 2011*

**Link:** http://tech.ebu.ch/events/s3d_technology_workshop

2D + depth + human factor = 3D!? In previous eras of 3D, many people could feel a discomfort while viewing 3D - some more, some less. And exactly this is the great unknown factor; the human factor, which plays a role in 3D. Today, the technology becomes better and better using the digital technology to improve the quality of 3D images, so that the number of problems for humans could be reduced. But be aware that every human is unique and will have a different reaction on different influencing factors while watching 3D.

MUSCADE researchers will continue to conduct their work for the next two years to improve the quality of 3D by inventing new ways of production, rendering, transmission or displaying, and will be involved in the process by creating a comfortable 3D imaging.

With the 3D workshop on "3D technology and human factors", which will be held at the European Broadcasting Union (EBU) headquarters in Geneva, Switzerland on 6th & 7th October 2011, the EBU invite you to get involved and demonstrate real human reactions on Stereo 3D (S3D). Therefore, presenters will consider S3D with a medical aspect and will give you advices on several critical aspects of human factors in 3DTV and live production. S3D basics, use cases as well as recommendations and the Human Visual System related aspects will be the main areas of interest at this workshop. While doing so, EBU also wish to create an open environment (through this workshop) for you to provide information and answer your questions about health issues while watching 3DTV.

*Announcement:*

*"Workshop on 3D Technology and Human Factors, EBU, Geneva, Switzerland, 6-7 October 2011"*

The registration for this event is not yet open, however further information can be obtained from the EBU website and/or by contacting Yvonne Thomas (thomas@ebu.ch).

**Submitted by: EBU**

# MUSCADE At International Forum Dimension 3

**Link:** http://www.dimension3-expo.com/

MUSCADE was represented by Astrium at the International Forum Dimension 3 which took place in La Plaine Saint Denis, France on 24-26 May 2011. The event featured 3 days of conferences, workshop and exhibitions and attracted 3800 visitors from 35 countries. During the session entitled "The future of 3D in 12 months, 5 years, 10 years", the latest MUSCADE outcomes in terms of content creation, transmission and rendering have been presented to a wide audience.

**Submitted by: Astrium**

# Publications Corner

## Rendering multi-view plus depth data on light-field displays

**Authors:** A. Ouazan, P.T. Kovacs, T. Balogh, and A. Barsi

**Affiliation:** Holografika

**Publication:** 5th IEEE 3DTV Conference (3DTV-CON 2011), Antalya, Turkey, 16-18 May 2011

**Link:** http://www.3dtv-con.org/3dtv-con-11/d2/

**Abstract:**

This paper presents an approach for rendering heavily extrapolated novel views to be used as input for light-field displays. This view generation method builds on a combination and enhancement of existing methods. The interpolation quality is assured by detecting and keeping the most reliable gap area information from the content using depth layers. Concerning the extrapolation process, which is the most important part of this paper, we implemented an algorithm that prefers isophotes lines in order to reconstruct objects and patterns using gradient filling and Poisson reconstruction. Using the algorithms described, it is possible to generate wide baseline light field data from Multi-View plus Depth (MVD) data of moderate baseline. The approach is demonstrated by generating interpolated and extrapolated views for feeding a HoloVizio large-scale display with captured video data.

## Extended VQM model for predicting 3D video quality considering ambient illumination context

**Authors:** G. Nur, H. Kodikara Arachchi, S. Dogan, and A.M. Kondoz

**Affiliation:** UNIS

**Publication:** 5th IEEE 3DTV Conference (3DTV-CON 2011), Antalya, Turkey, 16-18 May 2011

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

**Abstract:**

To speed-up the proliferation of advanced 3-Dimensional (3D) technologies into the consumer market, the influence of these technologies on the perception of 3D video should be determined. Currently, this can only be achieved using either subjective assessment techniques or 2D objective quality evaluation models. Even though the subjective assessment techniques are better than the objective models from the accuracy point of view, they are time consuming and costly. Thus, 2D objective quality evaluation models correlating with Human Visual System (HVS) should be used to predict the 3D video quality perception of users in a reliable way with less effort. Video Quality Metric (VQM), which is a standardized 2D objective quality measurement model due to its well correlation with HVS, is used to predict 3D video quality perception of users reliably. However, ambient illumination context of the viewing environment, which has an effect on 3D video quality perception, is not considered in the quality assessments by VQM. Content adaptation is one of the key applications that need to use the perceived 3D quality assessments under different ambient illumination conditions at regular basis for ensuring improved video experience of users. Therefore, the standardized VQM model is extended using ambient illumination context and content related contexts (i.e., motion, structural feature, and luminance contrast) to predict 3D video quality measurement under a particular ambient illumination condition in this paper. The results prove that the extended VQM model can be efficiently utilized to predict the video quality perception of 3D video under a particular ambient illumination condition.

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