The 3DTV Toolbox – The Results of the 3DTV NoE

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Workshop on 3DTV Broadcasting

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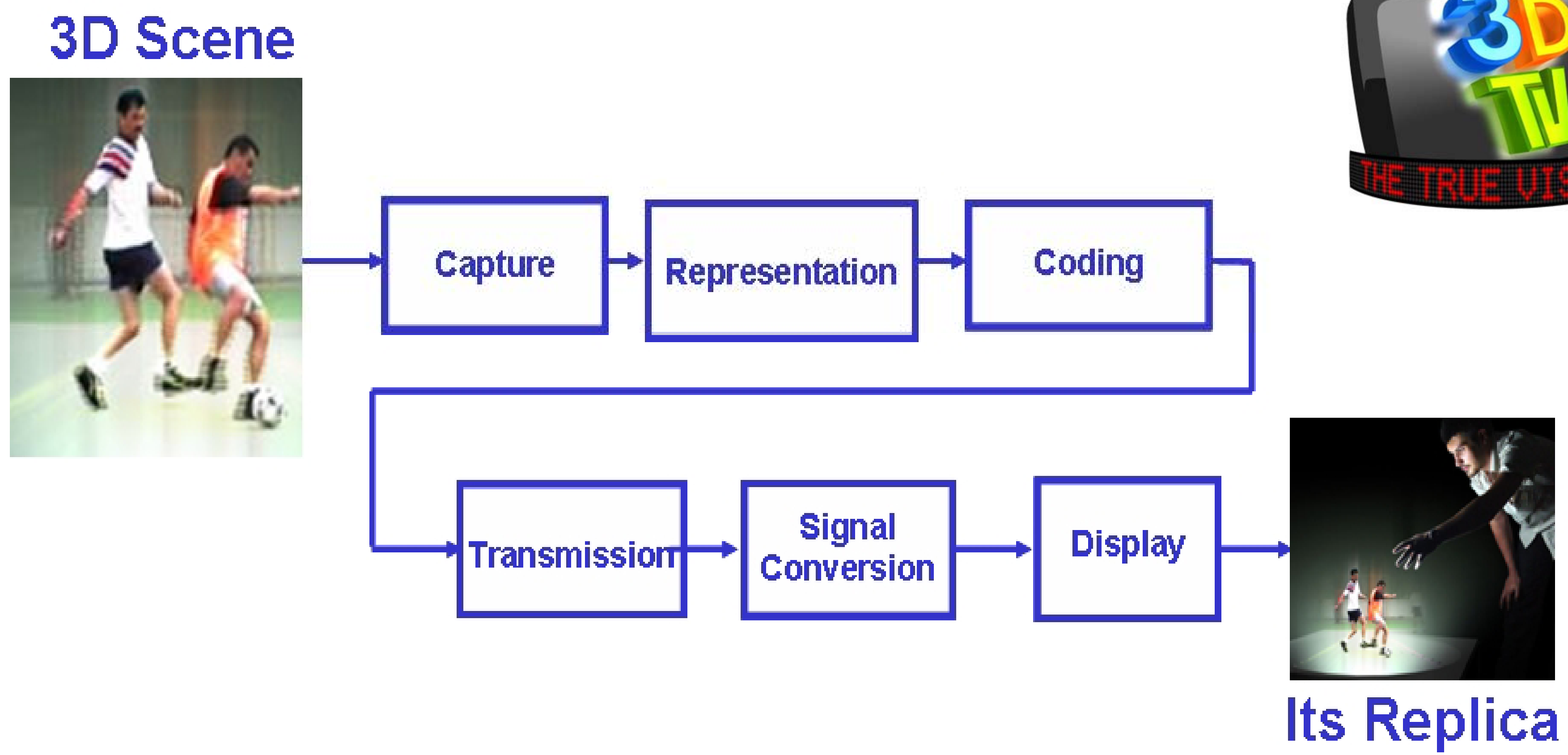
Artists vision of an ultra-realistic future 3DTV



The Technical Building Blocks for 3D Video Delivery

- "Realistic" ghost-like illusions have always been a goal
- 2D (still or motion) picture technologies are well developed and well accepted
- Unfortuntely 3D visualization mores are not as popular as their 2D counterparts

- **3D counterparts are almost as old as their 2D versions**
  - Stereoscopic 3D pictures – 1838 (Wheatsone)
    - Popular by 1844 in USA and Europe
  - 2D Photography – 1839
  - 2D Movies – 1867 (Lincoln)
  - 3D stereoscopic cinema – early 1900

- **3D counterparts are almost as old as their 2D versions**
  - 2D TV – 1920 (Belin and Baird)
  - Stereoscopic 3DTV – 1920 (Baird)
  - Stereoscopic 3D cinema was popular by 1950s
  - Stereoscopic 3DTV broadcast – 1953
  - First commercial 3DTV broadcast – 1980s

- Stereoscopy
  - Earliest form; known for ~170 years
  - Simplest, based on “perception”
  - Two simultaneaous video/image to two eyes
    - Color-based filtering (anaglyphs)
    - Polarization-based filtering
    - Shutter-based filtering
  - Other forms exist
    - Pulfrich effect stereoscopy

- Autostereoscopic Viewing
  - No special eye-wear
  - Lenticular or barrier technologies
    - Interzigging
  - Sweet-spot

- Multi-view Autostereoscopy
  - Many simultaneous horizontally spaced views
    - Usually 7-9 views; may go up to ~50
  - Some horizontal parallax

- Integral Imaging
  - Known since 1905
  - Microlens arrays during capture and projection
  - 2D array of many elemental images
  - Both vertical and horizontal parallax
  - Light field renderer in the limit
    - Replicates 3D physical light distribution: True 3D technique
    - "Incoherent Holography"

- Holography
  - Basic principle -1948, first holograms – 1960
  - Based on physics : duplication of light field: True 3D technique
  - Recording on
    - Photographic films
    - High resolution CCD arrays
  - 3D reconstruction by proper illumination of the recording
  - Digital holographic techniques
  - Experimental holographic motion pictures – 1989
  - Still at basic reseach phase

- Volumetric 3D Displays
  - Sweeping 3D volume either mechanically or electronically
    - Voxels
      - Self-luminous pixels
      - Moving projection screens
      - Varifocal lenses
  - Yields full-parallax

Comparative Analysis of Different 3D Techniques

- Stereoscopy is the simplest and oldest technique
  - It does not create physical duplicates of 3D light
  - Quality of resultant 3D effect is inferior
    - Lack of parallax
    - Focus and convergence mismatch
    - Mis-alignment
  - "Motion sickness" type of a feeling (Eye fatigue)
    - Main reason for commercial failure of 3D techniques

Comparative Analysis of Different 3D Techniques

- Mutli-view video provides some horizontal parallax
  - Still limited to a small angle (~20-45 degrees)
  - Jumping effect
  - Viewing discomfort similar to stereoscopy
  - Requires high-resolution display device
  - Leakage of neighboring images

Comparative Analysis of Different 3D Techniques

- Integral Imaging adds vertical parallax
  - Gets closer to an ideal light-field renderer as the number of lenses (elemental images) increase: True 3D
  - Alignment problem
  - Requires very high resolution devices
  - Leakage of neighboring images

Comparative Analysis of Different 3D Techniques

- Holography is superior in terms of replicating physical light distribution
    - Recording holograms is difficult
    - Very high resolution recordings are needed
    - Display techniques are quite different

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- It is highly desirable to decouple the capture and the display

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Capture:
  - Single camera techniques
  - Multi-camera techniques
  - Holographic capture devices
  - Pattern projection techniques
  - Time-of-flight techniques

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Representation:
  - Dense depth representation
  - Surface-based representations
  - Point-based representations
  - Volumetric representations
  - Texture mapping
  - Pseudo-3D representations
  - Light field representations
  - Object-based representations

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Representation:
    - Standards for 3D representation:
        - ISO, ITU and IEEE standards
        - Virtual Reality Modeling Language (VRML) (ISO, 1997)
        - Extensible-3D (X3D) (ISO, Web3DConsortium)
        - MPEG-4 with its extension AFX (3DAV group of MPEG)

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Coding:
  - Stereoscopic video coding:
    - ITU-T Rec. H.262/ISO/IEC 13818-2 MPEG-2Video (Multiview Profile)
  - Multiview video coding:
    - H264/AVC can be used for each view independently
    - ISO/MPEG and ITU/VCEG have recently jointly published a recommendation: MVC extension of H.264/AVC (Amendment 4).
  - Video-plus-depth:
  - 3D Mesh compression
  - Multiple description coding
  - Watermarking

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Streaming:
  - Analog Braodcast of 3DTV:
    - First experimental broadcast in 1953
    - First commercial broadcast in 1980
    - First experimental broadcast in Europe in 1982
    - All limited to a single movie, or an event

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Streaming:
  - Digital Broadcast of 3DTV
    - Japan, 1998
    - Korea, 2002
    - Mostly stereoscopic 3DTV
    - 3D Cinema is getting popular
    - Routine stereoscoic broadcast especially from popular sports events

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Streaming:
  - 3DTV over IP Networks
    - Streaming Protocols
      - RTP over UDP
      - DCCP
    - Multiview Video Streaming
    - Error correction and streaming
    - Video streaming experiments and demonstrations

State-of-the-Art in Imaging, Delivery and Display of 3D Content

- Displays:
  - Stereoscopic displays based on eye-wear are avaliable
  - Autostereoscopic displays are also available from many different vendors
    - Lenticular (Philips)
    - Barrier (Newsight)

State-of-the-Art in End-to-End 3DTV Systems

- Mostly stereoscopic
  - Popular sports event were broadcast in 1998, 2002, 2007 and 2009
- End-to-end 3DTV systems are very few
  - EC funded 3DTV Project (2004-2008)
  - Mitsubishi Electric Research Laboratories (MERL)
  - ETRI (3D video over T-DMB)
  - Video Coding and Architectures Group at Eindhoven Univ.

3D Video Related Communities and Events

- 3D Media Cluster
- 3D Consortium
- 3D@Home Consortium
- Association in Korea
- SMPTE 3D Cinema activities
- 3DTV-CON

3D Media Cluster

3D Media Cluster had its first meeting on 16 April 2008

(Levent Onural and Aljoscha Smolic are the cluster co-leaders)

www.3dmedia-cluster.eu

Membership:

EC FP7 Projects:

- **3DPHONE – (Coord: Bilkent U.)**
- **3D4YOU – (Coord: Philips)**
- **MOBILE3DTV – (T.U. Tampere)**
- **Real 3D – (Coord: U. Oulu)**
- **Helium3D (Coord: DMU)**
- **3DPresence (Coord: Telefonica)**
- **2020 3D Media (Coord: Barcelona Media)**
- **i3DPost (Coord: The Foundry)**
- **Victory (Coord: ITI-Certh)**

EC FP6 Projects:

- **3DTV NoE (Coord: Bilkent) (Project is ended on 31 Aug 2008)**
- **MUTED (Coord: DMU)**

3D Media Cluster

3D Video R&D

- **Short Term (immediate commercialization):**
- **Digital stereoscopic projection**
  - **Better/perfect alignment to minimize “eye-fatigue”**
- **End-to-end digital production-line for stereoscopic 3D cinema**
  - **Digital stereo cameras**
  - **Digital base-line correction for realistic perspective**
  - **Digital post-processing**

3D Media Cluster

3D Video R&D

– **Medium-term (Commercialization during the next few years):**

- **End-to-end multi-view 3D video with autostereoscopic displays:**
  - Cameras and automated camera calibration
  - Compression/Coding for efficient delivery
  - Standardization
  - View interpolation for free-view video
  - Better autostereoscopic displays, based on current and near-future technology (lenticular, barrier-based)
  - Natural immersive environments

3D Media Cluster

3D Video R&D

- **Long-term (10+ years):**
  - **Realistic/Ultra realistic displays**
  - **“Natural” interaction with 3D displays**
  - **Holographic 3D displays, including “integral imaging” variants**
  - **Natural immersive environments**
  - **Total decoupling of “capture” and “display”**
  - **Novel capture, representation and display techniques**

3D Media Cluster

3DPHONE project aims to develop technologies and core applications enabling a new level of mobile 3D experience, by developing an all-3D imaging mobile phone. The aim of the project is to realize all fundamental functions of the phone i.e. media display, user interface, and personal information management applications in 3D but usable without any stereo glasses.

Users will be able to:

- Capture memories in 3D and communicate with others in 3D virtual spaces
- Interact with their device and applications in 3D
- Manage their personal media content in 3D

Coordinator: Bilkent University, Turkey

3D Media Cluster

3D4YOU project will develop the key elements of a practical 3D television system, particularly, the definition of a 3D delivery format and guidelines for a 3D content creation process.

The project will develop 3D capture techniques, convert captured content for broadcasting and develop 3D coding for delivery via broadcast.

Coordinator: Philips, The Netherlands

MOBILE3DTV

Mobile 3DTV Content Delivery Optimization over DVB-H System

Objectives:

1. Develop optimal formats for stereo video content creation for mobile 3DTV.
2. Develop optimal codecs for mobile 3DTV
3. Develop optimal tools for error resilient transmission of mobile 3DTV content over DVB-H.
4. Gather new knowledge about user experience in mobile
5. Develop novel metrics for objective quality assessment of stereo-video streams
6. Develop optimal tools for stereo video quality enhancement
7. Develop a backward-compatible prototype portable device capable of receiving and displaying 3D video streams.
8. Build an end-to-end system enabling broadcasting of compressed and stored stereo-video content over a DVB-H channel.

Coordinator: Tampere University of Technology, Finland

Real 3D

Holographic Capture and Display

Project outputs will include building a digital 3D holographic capture, processing, and display arrangement that encompasses the full 360 degrees of perspectives of the 3D scene.

Coordinator: University of Oulu, Finland

Helium 3D is creating a 3D display that will extend the state of the art in autostereoscopic (glasses free) displays. The HELIUM3D display technology addresses the efficiency and colour limitations of current and next generation displays by developing a new display technology based on direct-view RGB laser projection via a low loss transparent display screen to the eyes of viewers.

The fundamental features of the display are:

· Support for multiple viewers

· Allow for viewer freedom of movement

· Motion parallax to all viewers

· High brightness and colour gamut

· Viewer gesture/interaction tracking

· User-centred design, ensuring that future products are “fit for purpose” in terms of perception and usability

Coordinator: DeMontfort University, UK

3D Presence project will implement a multi-party, high-end 3D videoconferencing concept that will tackle the problem of transmitting the feeling of physical presence in real-time to multiple remote locations in a transparent and natural way. In order to realize this objective, 3D Presence will go beyond the current state of the art by emphasizing the transmission, efficient coding and accurate representation of physical presence cues such as multiple user (auto)stereopsis, multi-party eye contact and multi-party gesture-based interaction.

Coordinator: Telefonica, Spain

3D Media Cluster

2020 3D Media will research, develop and demonstrate novel forms of compelling entertainment experiences based on new technologies for the capture, production, networked distribution and display of three-dimensional sound and images.

The goal is to explore and develop novel technologies to support the acquisition, coding, editing, networked distribution, and display of stereoscopic and immersive audiovisual content providing novel forms of compelling entertainment at home or in public spaces. The users of the resulting technologies will be both media industry professionals across the current film, TV and 'new media' sectors producing programme material as well as the general public.

Coordinator: Barcelona Media, Spain

i3DPost

Intelligent 3D content extraction and manipulation for film and games

i3DPost will develop new methods and intelligent technologies for the extraction of structured 3D content models from video, at a level of quality suitable for use in digital cinema and interactive games.

i3DPost will combine advances in 3D data capture, 3D motion estimation, post-production tools and media semantics. The result will be film quality 3D content in a structured form, with semantic tagging, which can be manipulated in a graphic production pipeline and reused across different media platforms.

Coordinator: The Foundry, UK

3D Media Cluster

VICTORY project which will develop an innovative, distributed search engine, introducing MultiPedia search and retrieval capabilities to a standard (PC-based) and a mobile P2P network. A MultiPedia object is defined as a 3D object along with its accompanied information i.e. 2D views, text, audio, video.

Coordinator: ITI-Certh, Greece

MUTED

Multi-user 3D Television Display

The MUTED project aims to produce a 3DTV display capable of supporting multiple mobile viewers simultaneously, and without the need for 3D glasses. The project will also be investigating ways in which 3D technology can enhance medical scans, allowing doctors and scientists to explore the resulting images in greater detail using 3D displays.

The main goals of the project are

* To design and evaluate the next generation of 3D displays
* To develop a display supporting multiple mobile viewers
* To eliminate the need for 3D glasses and the like
* The display must be relatively inexpensive
* The display must be a manageable size
* To allow 3D over a room-sized area
* To bring 3D to the consumer market within the next 10 years
* To implement the apparent practical need for 2D/3D mode switching in a display

Coordinator: De Montfort University, UK

www.3dtv-research.org

3DTV - Network of Excellence

Integrated 3DTV : Capture, Transmission and Display

- Many different competing technologies for capture, representation, coding, transmission and display are investigated
- Many projects in the 3D Media Cluster are spin-off projects from the recently completed 3DTV NoE in the sense that their coordinators or partners were also 3DTV NoE partners.

Coordinator: Bilkent University, Turkey

3DTV NoE - Achievements and Results

3DTV Project - Capture:

- A robot with a laser scanner and an omnidirectional camera is developed
- Several multi-camera systems are designed, implemented and tested
- Many techniques to generate automated human avatars
- Surface reconstructions of moving garment from multi-cameras
- SAR methods to improve CCD-based holographic recording resolution

3DTV NoE - Achievements and Results

3DTV Project – Representation:

- Performance assessments of different representation techniques
- Leading status at ISO MPEG activities; NoE originated point-based (dense) 3D representation is competing with other proposals
- Comparative virtual camera view synthesis under different representation models
- Constant connectivity time-varying mesh representations from multi-camera data

3DTV NoE - Achievements and Results

3DTV Project - Coding

- Strong influence on ISO and ITU standards on 3D
  - Video plus depth
  - Multi-view video coding (MVC)
    - Standard is now completed; NoE originated proposal won the competition
  - Multi-view video with depth (MVD)
    - Leading role of NoE
  - 3D Dynamic Mesh Compression
    - Leading role of NoE
- Multiple Description Coding
  - Leading role of NoE
- Watermarking
- Holographic pattern compression

3DTV NoE - Achievements and Results

3DTV Project – Video Streaming:

- End-to-end platform for streaming 3D video over IP
- Novel streaming methods with congestion control (DCCP)
- Extensions to RTP and SDP protocols for 3D video streaming
- Optimal cross-layer packet scheduling for 3D video streaming
- Robust streaming (Error resilient encoding and transport)
  - Packet loss resilience over wired and wireless channels
  - Different approaches for error concealment for stereo images
- Streaming over DVB-H
- Selective streaming
- Peer-to-peer streaming
- Wireless applications
- Application of Turbo codes to 3D
- Depth representation based end-to-end 3DTV tests
- Effects of lossy channels are investigated

3DTV NoE - Achievements and Results

3DTV Project – Signal Processing for Diffraction and Holography:

- Computing monochromatic fields from deflectible mirror array devices
- Compression of holographic data using electromagnetic properties
- Fast computation between tilted planes
- Computation of diffraction patterns from distributed data points
- Phase-retrieval techniques for 3D shape measurements
- Speckle noise reduction techniques
- Mathematical tools to facilitate solutions of diffraction related problems
- Exact analysis of sampling effects in diffraction
- Algorithms for optical holographic displays using SLMs
- Fast and efficient algorithms to synthesize holograms

(Continues)

3DTV NoE - Achievements and Results

3DTV Project - Signal Processing for Diffraction and Holography:

(Cont's):

- SAR techniques for holographic recording
- Wavefield reconstruction techniques based on discrete inverse problems
- Fast and efficient photorealistic hologram synthesis
- Phase unwrapping techniques under noisy conditions
- Multi-wavelength pattern projection techniques for 3D shape measurements
- Cross-talk measurements for autostereoscopic displays
- Methods to measure optical characteristics of slanted parallax barier multiview 3D displays
- Fast procedures to reduce cross-talk in multi-view displays

3DTV NoE - Achievements and Results

3DTV Project - Displays and Applications:

- Assessment of displays
  - Methodologies are developed
  - Human factors
- Improvements on holographic displays
- Head-trackig autostereoscopic displays
- Sophisticated SLM-based holographic display laboratories
- Computer genertated holography for SLMs
- Light source development
- Development of new photopolymer materials

(Continues)

3DTV NoE - Achievements and Results

3DTV Project – Displays and Applicaitons (Continued):

- Applications
  - Fire simulation
  - Gaming applications
  - Cultural heritage
  - Football simulation
  - Air traffic control
  - Holography in life sciences
  - 3D Mobile phone applications
- Roadmaps
  - Roadmap to holographic displays
  - Roadmap for autostereoscopic displays
  - Roadmap for applications
- Market Survey

3DTV NoE - Achievements and R

- **3DTV Project – Contributions to Standardization Activities:**
  - Many 3DTV Project partners are active in MPEG and ITU activities
  - MPEG-C Part 3 is released in Jan 2007
  - H264/AVC (MPEG-4 Part 10 Amd. 4) (MVC) (2008)
    - » Winning proposal is originated from our 3DTV Project
  - Our 3DTV Project originated proposals triggered dynamic 3D mesh compression activities in MPEG (Now an integral part of AFX)

3DTV Project - Publications:

- **355 papers (65 journal, 273 conference, 17 book chapters)**

3DTV NoE - Some publications

1568 IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 17, NO. 11, NOVEMBER 2007

3-D Time-Varying Scene Capture Technologies—A Survey

Elena Stoykova, A. Aydın Alatan, *Member, IEEE*, Philip Benzie, *Member, IEEE*, Nikos Grammalidis, Sotiris Malassiotis, Joern Ostermann, *Fellow, IEEE*, Sergej Piekh, Ventseslav Sainov, Christian Theobalt, Thangavel Thevar, and Xenophon Zabulis

(Invited Paper)

***Abstract*—Advances in image sensors and evolution of digital computation is a strong stimulus for development and implementation of sophisticated methods for capturing, processing and analysis of 3-D data from dynamic scenes. Research on perspective time-varying 3-D scene capture technologies is important for the upcoming 3DTV displays. Methods such as shape-from-texture, shape-from-shading, shape-from-focus, and shape-from-motion**

I. Introduction

THREE-DIMENSIONAL television (3DTV) is expected to evoke a revolution in visual technology. Beyond any doubt, precise acquisition of 3-D information of dynamic scenes is crucial for 3DTV implementation. Extensive research has been

3DTV NoE - Some publications

IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 17, NO. 11, NOVEMBER 2007 1587

Scene Representation Technologies for 3DTV—A Survey

A. Aydın Alatan, *Member, IEEE*, Yücel Yemez, *Member, IEEE*, Uğur Güdükbay, *Senior Member, IEEE*, Xenophon Zabulis, Karsten Müller, *Senior Member, IEEE*, Çiğdem Eroğlu Erdem, *Member, IEEE*, Christian Weigel, and Aljoscha Smolic

(Invited Paper)

***Abstract*—3-D scene representation is utilized during scene extraction, modeling, transmission and display stages of a 3DTV framework. To this end, different representation technologies are proposed to fulfill the requirements of 3DTV paradigm. Dense point-based methods are appropriate for free-view 3DTV applications, since they can generate novel views easily. As surface representations, polygonal meshes are quite popular due to their generality and current hardware support. Unfortunately, there is no inherent smoothness in their description and the resulting potential for use in a 3DTV framework for modeling and animating dynamic scenes. As a concluding remark, it can be argued that 3-D scene and texture representation techniques are mature enough to serve and fulfill the requirements of 3-D extraction, transmission and display sides in a 3DTV scenario.**

***Index Terms*—Animation, dense depth map, modeling, MPEG-4, nonuniform rational B-spline (NURBS), octree, point-based modeling, polygonal mesh, pseudo-3D, rendering, scene representation, subdivision surfaces, texture, volumetric representation, VRML.**

3DTV NoE - Some publications

1606 IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 17, NO. 11, NOVEMBER 2007

Coding Algorithms for 3DTV—A Survey

Aljoscha Smolic, Karsten Mueller, *Senior Member, IEEE*, Nikolce Stefanoski, *Student Member, IEEE*, Joern Ostermann, *Fellow, IEEE*, Atanas Gotchev, *Member, IEEE*, Gozde B. Akar, *Senior Member, IEEE*, Georgios Triantafyllidis, *Member, IEEE*, and Alper Koz, *Member, IEEE*

(Invited Paper)

***Abstract*—Research efforts on 3DTV technology have been strengthened worldwide recently, covering the whole media processing chain from capture to display. Different 3DTV systems rely on different 3-D scene representations that integrate various types of data. Efficient coding of these data is crucial for the success of 3DTV. Compression of pixel-type data including stereo video, multiview video, and associated depth or disparity maps extends available principles of classical video coding. Powerful**

I. Introduction

EXTENDING visual sensation to the third dimension has been investigated over decades. However, significant consumer mass markets haven't developed yet. 3-D video is established in niche markets, including professional applications (e.g., scientific visualization, medicine) and entertainment

3DTV NoE - Some publications

1622 IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 17, NO. 11, NOVEMBER 2007

Transport Methods in 3DTV—A Survey

Gozde B. Akar, *Senior Member, IEEE*, A. Murat Tekalp, *Fellow, IEEE*, Christoph Fehn, and M. Reha Civanlar, *Fellow, IEEE*

(Inivted Paper)

***Abstract*—We present a survey of transport methods for 3-D video ranging from early analog 3DTV systems to most recent digital technologies that show promise in designing 3DTV systems of tomorrow. Potential digital transport architectures for 3DTV include the DVB architecture for broadcast and the Internet Protocol (IP) architecture for wired or wireless streaming. There are different multiview representation/compression methods for delivering the 3-D experience, which provide a tradeoff between compression efficiency, random access to views, and ease of rate adaptation, including the "video-plus-depth" compressed representation and various multiview video coding (MVC) options**

by multiple views, to enable viewers to watch the 3-D scene from different angles within a limited viewing range on 3-D displays that support this functionality.

The history of 3-D visual motion imagery can be traced back to 1903, when the first stereoscopic 3-D movie was created. This could only be watched from a fixed viewing angle by one viewer at a time with a modified stereoscope. In 1922, the first full length stereoscopic movie was shown simultaneously to a large group of viewers using the anaglyphic process. Hollywood

3DTV NoE - Some publications

IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 17, NO. 11, NOVEMBER 2007 1631

A Survey of Signal Processing Problems and Tools in Holographic Three-Dimensional Television

Levent Onural, *Senior Member, IEEE*, Atanas Gotchev, *Member, IEEE*, Haldun M. Ozaktas, and Elena Stoykova

(Invited Paper)

***Abstract*—Diffraction and holography are fertile areas for application of signal theory and processing. Recent work on 3DTV displays has posed particularly challenging signal processing problems. Various procedures to compute Rayleigh–Sommerfeld, Fresnel and Fraunhofer diffraction exist in the literature. Diffraction between parallel planes and tilted planes can be efficiently**

used in 3DTV displays in Section II. An analytical approach to holographic 3DTV is only possible if the underlying fundamentals of diffraction are understood; therefore, we provide a brief introduction to diffraction in Section III and point out that basic forms describing diffraction are already familiar to signal

3DTV NoE - Some publications

IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 17, NO. 11, NOVEMBER 2007 1647

A Survey of 3DTV Displays: Techniques and Technologies

Philip Benzie, *Member, IEEE*, John Watson, *Senior Member, IEEE*, Phil Surman, Ismo Rakkolainen, Klaus Hopf, Hakan Urey, *Member, IEEE*, Ventseslav Sainov, and Christoph von Kopylow

(Invited Paper)

***Abstract*—The display is the last component in a chain of activity from image acquisition, compression, coding transmission and reproduction of 3-D images through to the display itself. There are various schemes for 3-D display taxonomy; the basic categories adopted for this paper are: holography where the image is produced by wavefront reconstruction, volumetric where the image is produced within a volume of space and multiple image displays where two or more images are seen across the viewing field. In an ideal world a stereoscopic display would produce images in real time that exhibit all the characteristics of the both vertical and horizontal parallax and several viewers are able to see a 3-D image that exhibits no accommodation/convergence rivalry. However, the principal disadvantages of these displays are: the images are generally transparent, the hardware tends to be complex and non-Lambertian intensity distribution cannot be displayed. Multiple image displays take many forms and it is likely that one or more of these will provide the solution(s) for the first generation of 3DTV displays.**

***Index Terms*—Holography, TV, 3-D displays.**

3DTV NoE - Some publications

Proceedings of IEEE 2007

POINT OF VIEW

Television in 3-D: What Are the Prospects?

BY LEVENT ONURAL, ***Senior Member IEEE***
3DTV Project Coordinator, Professor
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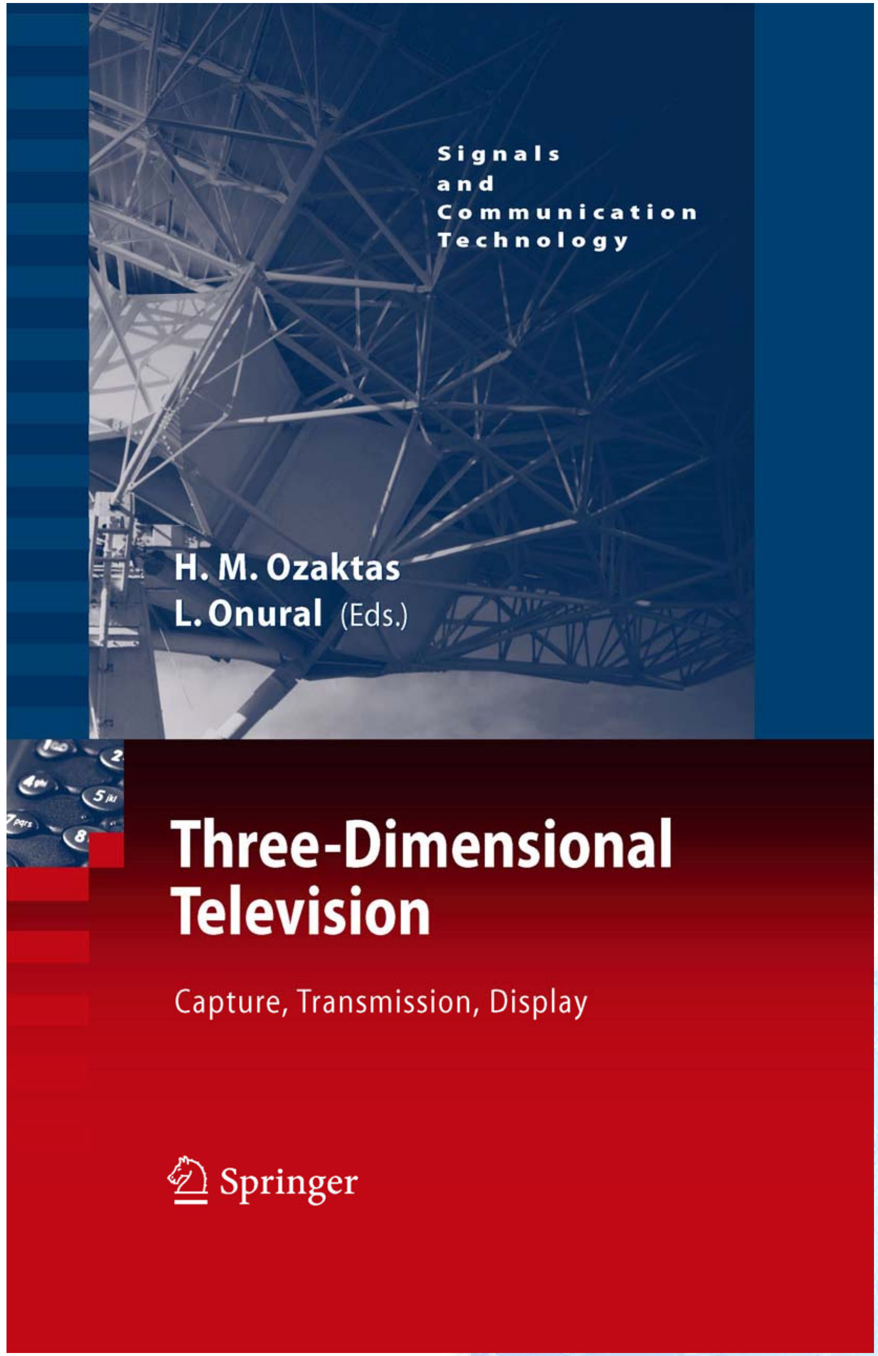
Signals
and
Communication
Technology
H. M. Ozaktas
L. Onural (Eds.)
Three-Dimensional
Television
Capture, Transmission, Display
Springer

Thank you…

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www.3dmedia-cluster.eu

www.3dtv-research.org