32nd Annual Stereoscopic Displays and Applications Conference - Introduction

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Abstract

This document provides an overview of the 32nd Stereoscopic Displays and Applications conference and also serves as an introduction to the conference proceedings.

Introduction

The 32nd annual Stereoscopic Displays and Applications (SD&A) conference was very different to all previous SD&A conferences because it was held fully online. The 2020 SD&A conference was fortunate to just clear the start of the widespread outbreak of the COVID-19 pandemic, but no such luck for the 2021 conference. The 2021 SD&A conference was originally planned to be held in downtown San Francisco, however it was soon obvious this was not going to be possible, and "the show must go on" so the IS&T and conference chairs worked very hard to quickly pivot the SD&A conference, and the whole Electronic Imaging (EI) Symposium, to a fully online format.

The online version of the Electronic Imaging Symposium necessitated some careful adjustments to the schedule since attendees were located all around the world in almost every time zone. The first adjustment was to hold the symposium over a period of three weeks (11-28 January), rather than the usual five days. This created a more relaxed schedule which allowed more flexibility. The first week was short courses, and week two and three were the conference presentation sessions.

The other adjustment was that the daily schedule was split into a US East Coast morning session (which was also convenient for attendees in Europe) and a (US East Coast) late afternoon/evening session (which was also convenient for attendees in the Asia/Pacific region). Of course, some of the sessions would occur at an inconvenient time for some of the attendees so all presentations were recorded and made available for offline viewing.

The online format used a range of different session types to try to reproduce the friendly and personable atmosphere that EI is known for. As well as the online presentation sessions which allowed for real-time question and answer option for the audience, as well as break-out rooms, demonstration sessions, and also a Discord channel for online chat.

This introduction document provides a summary of the wide range of activities and events that took place at the 2021 online conference. One thing that didn't change was that the conference still attracted a strong mix of attendees from both industry and academia including those who spoke in the plenaries, keynotes and technical sessions.

This year the conference had 21 oral presentations across the three days of the conference. Two of the conference sessions were held jointly with the Engineering Reality of Virtual Reality conference (ERVR).

The final conference program is available on the long-running SD&A conference website:

www.stereoscopic.org/2021

The program page also lists which presentations have an accompanying manuscript (and where to find it) and those that don't. Some of the papers are published in the Journal of Imaging Science and Technology (JIST) and are indicated with the designation "JIST first" since manuscripts submitted this way go through an accelerated full review process.

All of the published manuscripts from SD&A 2021 along with the other papers from the 2021 Electronic Imaging Symposium will be published in the IS&T Digital Library on the Ingenta Connect platform at:

http://ist.publisher.ingentaconnect.com/content/ist/ei

Papers in the joint sessions can only appear in one proceedings volume so they may appear in the proceedings volume of one of the contributing conferences rather than the SD&A proceedings. The SD&A 2021 program page will provide a direct link to each of the manuscripts without needing to worry about which particular conference or journal site they appear in – just visit:

www.stereoscopic.org/2021

All manuscripts from the SD&A 2021 conference and the wider Electronic Imaging Symposium are published Open Access which significantly improves the accessibility of SD&A authors' work and help you, the reader, access new and important developments in this field.

As well as the conference sessions running fully online, the technical short course "Stereoscopic Imaging Fundamentals" hosted by Andrew Woods also ran online over two days, and perhaps even more challenging, the annual 3D theater session also ran online.

SD&A 3D Theater Session

The 3D Theater session has been a regular fixture of the SD&A conference for the past 20+ years, and with the move of this year's conference to an online event it provided an opportunity for us to do something different this year. Thanks to the organisational efforts of lead-producer John Stern, expert online production by Eric Kurland, and production assistance by Dan Lawrence, this year's 3D Theater session was also held fully online and attendees were able to watch the SD&A 3D Theater session films from the comfort of their loungeroom. The films screened in the 2021 3D Theater session were selected from winning films over the past ten years of the SD&A 3D Theater session. The event was

"broadcast" live on YouTube in both anaglyph 3D (for people to watch using red/cyan anaglyph glasses) and over-under 3D formats (for people to watch on a 3DTV), and was hosted by Eric Kurland in 3D from his studio in Los Angeles, along with a 3D cross to Andrew Woods in Australia for the introduction.

There were three identical staggered "live-stream" screenings of the 3D Theater session timed to suit attendees in the Americas, Europe, and Asia. The session was free and open to public, and started Saturday 16 January.

The 3D films, and which SD&A award they won, are listed below:

1. *Stereo: A Love Song to 3D*, Creator and star: Robert Bloomberg; Motion graphics and co-animator: Pad McLaughlin (USA),
   🏆 2018 Animation Award.
2. Albuquerque Balloon Festival – Mass Ascension*, John Hart (USA),*
   🏆 2019 Live Action Award*.*
3. *White Knuckles, OK Go*, OK Go (USA),
   🏆 2011 Live Action Award.
4. *Amongst*, Chisa Hidaka and Benjamin Harley (USA),
   🏆 2016 Live Action Award.
5. *Chlamydomonas reinhardtii 3D – From Biological Cells to Biofuels*, Niklas Biere, Bjorn Sommer (Germany / Australia),
   🏆 2016 Animation Award.
6. *ENT3D Project Explained*, Peter J. Casano, M.D. (USA),
   🏆 2020 Hybrid Award.
7. *Chrysalis*, Ina Conradi and Mark Chavez (Singapore),
   🏆 2017 Animation Award.
8. *Ninety Three Million Miles*, Site-Eye Time-Lapse Films (dir: Brian McClave and Gavin Peacock) (UK),
   🏆 2013 Live Action Award.
9. *The Simple Carnival – Go Away I Like You Too Much*, Jeff Boller (USA),
   🏆 2019 Animation Award.
10. *Interrupted Dreams*, Aleksey Osipenkov (Russia),
    🏆 2020 Animation Award.
11. *Dead Boring 3D*, Dave Edwardz, Australian Film and Television School (Australia),
    🏆 2011 VFX Award.
12. *Morpheos Trailer*, John Hart (USA),
    🏆 2014 Animation Award.
13. *Formosa 3D*, Charlie Chu (Taiwan),
    🏆 2018 Live Action Award.
14. *Cochemare*, Chris Lavis and Maciek Szczerbowski (Canada),
    🏆 2015 Animation Award.
15. *All Is Not Lost*, OK Go and Pilobolus (USA),
    🏆 2012 Best of Show Award.
16. *The Whitewashing of 5 Pointz*, Ben Schwartz (USA),
    🏆 2015 Live Action Award.
17. *Little Planet in Stereoscopic 3-D*, STEREOeYe / Takashi Sekitani (Japan),
    🏆 2020 Live Action Award.

The event was well attended and received very good feedback from attendees. There were 185 event registrants via Eventbrite, and the screening on YouTube received the following attendance numbers of the two format options combined:
- o Screening 1 (New York): 77
- o Screening 2 (Tokyo): 33
- o Screening 3 (Paris): 57
- o Total: 167

The approximate mix of viewers watching in Full-3D vs. anaglyph was: 60% / 40%.

An informal favorite amongst the producers was "All is Not Lost" – see Figure 1. In 3D the film had a special extra dimension – pardon the pun.

Figure 1. A still frame from 2012 Best of Show Award winner "All Is Not Lost" by OK Go and Pilobolus (USA).

First Day

The first day of the conference had five technical sessions – three in the morning and two in the evening.

The conference kicked off with a special invited session with two presentations. The first technical presentation of SD&A 2021 was titled "Looking back at a wonderful decade shooting live-action 3D" by Demetri Portelli, I.A.T.S.E. International Cinematographer's Guild (Canada) – see Figure 2. His presentation built upon his experience working on multiple high-budget high-profile 3D movies as stereographer or stereoscopic supervisor.

Figure 2. Demetri Portelli delivers his SD&A Invited presentation "Looking back at a wonderful decade shooting live-action 3D".

The second presentation of SD&A Invited session was titled "When 3D headache will be over: A decade of movie quality measurements" by Dmitriy Vatolin, Lomonosov

Moscow State University (Russian Federation) – see Figure 3. Dmitriy and his colleagues have been doing an amazing amount of work analysing and quantifying stereoscopic alignment anomalies and other metrics in theatrically released 3D films, and this presentation overviewed this work.
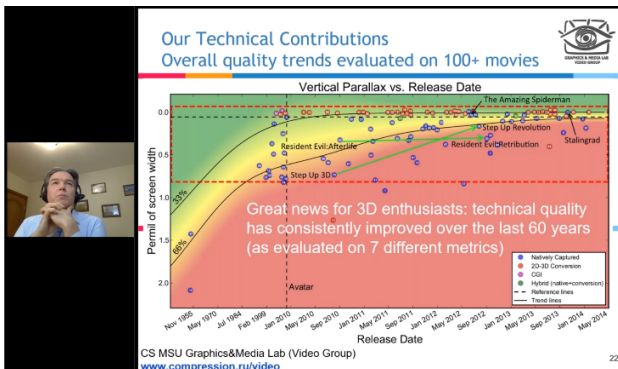

Figure 3. Dmitriy Vatolin delivers his SD&A Invited presentation "When 3D headache will be over: A decade of movie quality measurements".

Completing the morning session were two sessions on "Stereoscopic Developments" and "Stereoscopic Displays, Cameras, and Algorithms".

In the evening session things kicked off with a session on "Autostereoscopic Displays" followed by the conference's second keynote presentation, this time "Underwater 3D system for ultra-high resolution imaging" by Pawel Achtel from Achtel Pty Limited (Australia) – see Figure 4. Pawel's presentation provided an important insight into the technology and analysis behind obtaining high-quality underwater 3D visuals for the three Avatar movie sequels and other projects.
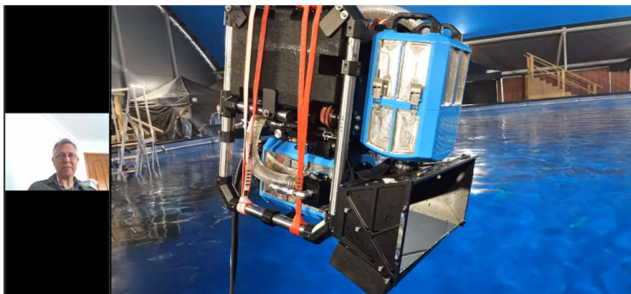

Figure 4. Pawel Achtel delivers his SD&A Keynote presentation "Underwater 3D system for ultra-high resolution imaging". The image on the right in his presentation is an underwater stereoscopic cinematography camera used to film underwater sequences for the three Avatar sequel films.

The full listing of the individual presentation in these sessions are listed on the conference program web page:
www.stereoscopic.org/2021

Second Day

The second day of the conference started with a symposium-wide plenary session titled "Deep internal learning—Deep learning with zero examples" by Michal Irani, Professor in the Department of Computer Science and Applied Mathematics at the Weizmann Institute of Science (Israel).

In the evening there was an SD&A session on "Stereoscopic Content and Quality", a short demonstration session for one of the papers, and the second SD&A Keynote presentation on "Digital Stereoscopic Microscopy" by Michael Weissman, SB3D Technologies, Inc. (United States) – see Figure 5. Michael's presentation discussed the history of stereoscopic microscopy and future opportunities with new design techniques.
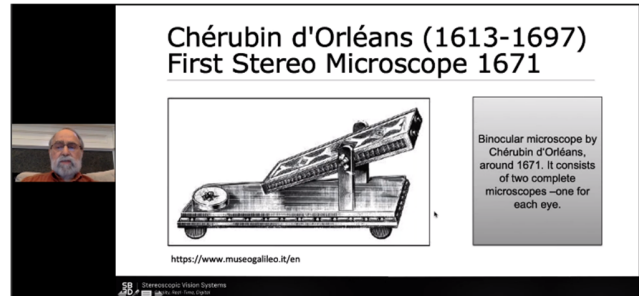

Figure 5. Michael Weissman delivers his SD&A Keynote presentation "Digital Stereoscopic Microscopy". The image on the right is from his presentation and describes the first stereoscopic microscope developed in 1671.

Third Day

The third day of the SD&A conference started with the second symposium-wide plenary session titled "The development of integral color image sensors and cameras" by Kenneth A. Parulski, Expert Consultant: Mobile Imaging (United States).

In the evening there were two technical sessions of the Engineering Reality of Virtual Reality conference titled "Immersive Experiences" and "VR and 3D Applications" held jointly with the SD&A conference.

Demonstration Session

The 2021 SD&A Demonstration Session was held 6-8pm New York time on Wednesday 20 January. This year our Demonstration Chair Bjorn Sommer outdid himself by using a new online platform called "Gather.Town" to hold the session. The Demonstration Session has been an incredibly important part of the SD&A conference for almost the entire 32-year history of the conference. The Demonstration Session provides the opportunity for attendees to meet individually with authors, look at and hear about new technologies, and informally bump into other conference attendees and chat. Most online conference platforms don't reproduce this type of atmosphere – mostly being suitable for lecture, seminar or workshop type environments, but Gather.Town allows users to see each other in the hall but only talk to them via video and audio when they approach each other.

In preparation for the session, Bjorn setup a map which reproduced the look of the usual SD&A Demonstration Session hall – as can be seen in Figure 6. Presenters have tables around the hall and they are able to chat with attendees when approached. Of course, this is all reproduced digitally. All attendees and presenters have an animated character they can 'walk' around the map. When two (or more) characters approach each other (within a nominated range) an audio/video channel is activated, and they can see each other and talk to each other. The power of the platform is that multiple conversations can be happening in parallel without

interrupting each other. Each of the presenters can be individually video-chatting with people at their booth, and equally attendees in the central part of the hall who are close to each other can be chatting to each other there too.

Figure 6. The SD&A Demonstration Session hall on Gather.Town.

This year the demonstration session presenters and their demonstrations were:

- Takashi Kawai from Waseda University (Japan) introduced an award ceremony held in a virtual space by the Japan Chapter of the Advanced Imaging Society titled "Application of 3D Avatars in a Virtual Event"
- Chris Ward and Dan Lawrence from DepthQ (USA) demonstrated their DepthQ VR AQUA experience (see Figure 7).
- Bjorn Sommer from the Royal College of Art (UK) presented the working prototype for his paper Hybrid Stereoscopic Photography - Analogue Stereo Photography meets the Digital Age with the StereoCompass app" (see Figure 8).
- Andrew Woods from Curtin University (Australia) demonstrated the method of testing passive-polarised 4K 3D TVs for correct operation using a simple test pattern.
- Eric Kurland from 3-D Space Museum (USA) demonstrated his live 3D video streaming studio solution which he used for the 2021 SD&A 3D Theater Session (see Figure 9,10,11).
- Pawel Achtel from Achtel.com (Australia) presented his 3D Film Services and Equipment for Giant Screen and IMAX Cinema.
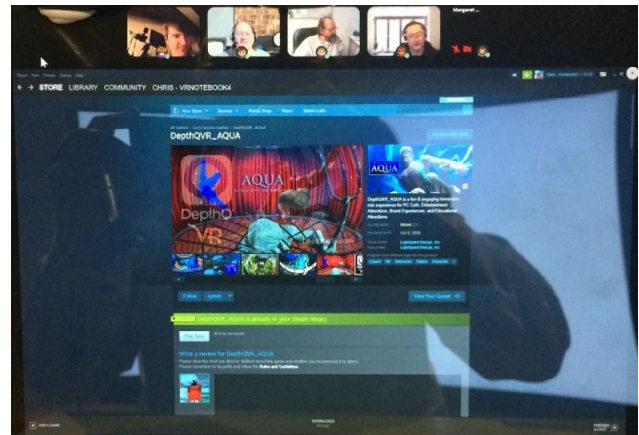

Figure 7. Chris Ward and Dan Lawrence from DepthQ demonstrated their DepthQ VR AQUA experience.

Figure 8. Bjorn Sommer presented his new StereoCompass app which can be used to plan and document stereo camera settings: Left: StereoCompass app, Centre: Two analogue SLR cameras on a tripod; Right: Red-Cyan photo of the Magic Column of Peter Lenk in Meersburg.
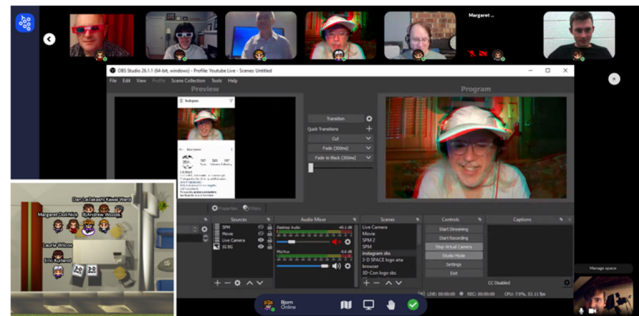

Figure 9. Eric Kurland from 3-D Space Museum demonstrated his live 3D video streaming studio solution using OBS Studio and other tools. You will also notice Eric's Gather.Town booth was crowded with attendees – bottom-left of image.
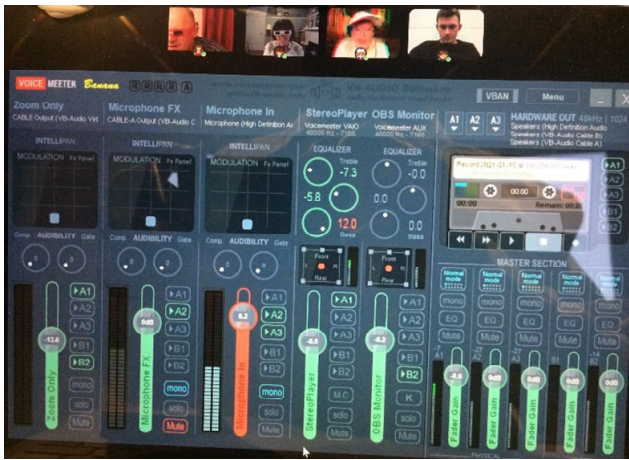
Figure 10. Eric Kurland from 3-D Space Museum demonstrated the audio mixing solution he was using tor his live 3D video streaming

Figure 11. Eric Kurland was streaming himself in anaglyph 3D and some of the attendees were wearing their anaglyph 3D glasses to see Eric in 3D.

During the demonstration session attendees could be seen wandering the hall, visiting all the booths, and having a fun time chatting with exhibitors – all whilst in lock-down.

Second Week

In the subsequent week, as well as more EI conferences and more EI technical presentations, there were two additional symposium-wide plenary presentations:

- "Making invisible visible" by Associate Professor Ramesh Raskar, MIT Media Lab (United States), and
- "Revealing the invisible to machines with neuromorphic vision systems: Technology and applications overview" by Luca Verre, CEO and Co-Founder at Prophesee (France).

Importantly the EI Symposium was also very pleased to be able to award Professor Raskar with the 2021 Electronic Imaging Scientist of the Year Award! (See Figure 12) Professor Raskar presented a keynote presentation at the SD&A conference in 2011 and we were very pleased to see him receive this year's award.

Figure 12. Associate Professor Ramesh Raskar is awarded the Electronic Imaging 2921 Scientist of the Year by EI 2021 chair Jonathan Phillips.

Also receiving an award at this event was long-time SD&A conference attendee, and also SD&A Keynote alumnus, Kurt Hoffmeister who was presented with an IS&T Honorary Membership by IS&T President Scott Silence – see Figure 13.
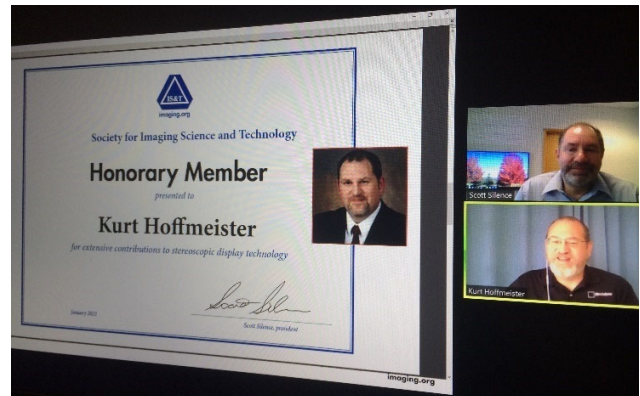

Figure 13. Kurt Hoffmeister receives his Honorary Member award from IS&T President Scott Silence.

Discussion

Many individuals and companies contribute each year in various ways to make the SD&A conference a successful event.

Most importantly, we thank the conference authors and attendees, who make this meeting such a successful event.

Thanks to the demonstration session presenters for bringing equipment to show – especially to the presenters who brought equipment from overseas.

We are grateful to all of the providers of 3D content for allowing their content to be shown to the conference audience at the 3D Theater Session.

The conference committee plays an important role throughout the year, ensuring the correct technical direction of the meeting. Sincere thanks go to our founding chair, John Merritt, and our committee: Neil Dodgson, Justus Ilgner, Eric Kurland, Bjorn Sommer, John Stern, Chris Ward and Laurie Wilcox.

Thanks also to the staff at IS&T - the organizing society instrumental in organizing all manner of aspects for the

meeting – and in particular Suzanne Grinnan, Marion Zoretich, Ann McCarthy and Donna Smith.

This was a very different year for SD&A so we wish to thank everyone for adapting so quickly to the new circumstances and attending virtually. Despite the rolling time zones, some of our attendees attended all of the SD&A sessions, regardless of their regular sleeping pattern.

Conference activities do not stop at the end of the annual meeting. The SD&A conference website and LinkedIn group provide a focus for conference activities during the time between conferences. We will soon be actively seeking abstracts for the 2022 conference, with a submission deadline in mid-2022 – see the Electronic Imaging website www.ElectronicImaging.org and the SD&A website www.stereoscopic.org for details and deadlines.

The SD&A website also has an extensive collection of photographs highlighting the activities of past conferences. In addition, the website hosts the stereoscopic virtual library, which contains several historically important books that have been digitized, in full, into PDF format, and are available for free download.

The SD&A conference maintains a Tweeter feed at @SDnAconf to keep everyone informed about SD&A events and activities. Check out the conference Twitter feed for details:

https://twitter.com/SDnAconf

The SD&A conference also has a LinkedIn group which is available at:

www.linkedin.com/groups?gid=1945944

Let's also not forget the SD&A conference announce-only mailing list. Visit here to sign up:

https://lists.curtin.edu.au/mailman/listinfo/sdalist

Since this year's event was online, there aren't as many photographs as we usually take – apart from the ones that are included in this document. Photographs from previous SD&A conferences are available in a special album on Flickr:

https://www.flickr.com/photos/124926259@N05/albums/with/72157665961383588

You can visit the conference website to gain an understanding of the past, present, and future of stereoscopic imaging. Please think now about submitting a paper or attending next year's conference. The Stereoscopic Displays and Applications conference website is at:
www.stereoscopic.org

Conclusion

Next year's SD&A conference will be held in January 2022 as part of annual IS&T Electronic Imaging Symposium. At this stage the event is planned to be a hybrid online and in-person event. The in-person event will be held at the Parc 55 San Francisco Hotel in downtown San Francisco, California. The hotel is within one block of the Powell Street BART station which provides easy access to San Francisco International (SFO) airport.

The 2022 SD&A conference will continue a tradition of presenting and demonstrating the latest technologies relevant to stereoscopic displays and applications. Please consider attending, presenting, or demonstrating at the 2022 event. We hope to see you there – either online or in-person!

Author Biographies

Andrew Woods is an Associate Professor at Curtin University where he manages the HIVE visualisation facility and is a Research Engineer at the Centre for Marine Science & Technology. He specialises in visualisation, stereoscopic 3D imaging, 3D reconstruction, 3D cameras and displays, video electronics, underwater vehicles (ROVs), and engineering software development, with applications in offshore oil and gas, and maritime archaeology. He has BEng and MEng degrees in electronic engineering and his PhD was on the topic of crosstalk in stereoscopic displays. He was the technology lead on the Sydney-Kormoran Project which surveyed the wrecks of HMAS Sydney (II) and HSK Kormoran in 2015, and imaging lead for the survey of the wreck of HMAS AE1 in 2018. In 2017 he was recognised as one of Australia's Most Innovative Engineers by Engineers Australia. He has been co-chair of the Stereoscopic Displays and Applications conference since 2000.

Nick Holliman is Professor of Visualization at Newcastle University researching the science and engineering of visualization and visual analytics including the fundamental challenges of visualizing big data. This includes working with psychologists to understand how the human visual system processes information, developing novel computational algorithms for the control of image content and demonstrating how these algorithms work in practice in cloud-based software tools and award winning stereoscopic 3D visualizations. He has worked in both industrial and academic environments and is experienced in delivering commercial impact from research outputs.

Gregg Favalora is Group Leader: Sensors and Imaging Systems at Draper (Cambridge, MA, USA) where his work includes the development of electroholographic light modulator systems. He holds a BS (EE) from Yale University and an SM from Harvard University. From 1997 - 2009, Gregg was CTO of autostereoscopic display developer Actuality Systems, Inc., which created the Perspecta volumetric display and other advances in visualization.

Takashi Kawai is a Professor in the Department of Intermedia Art and Science, Faculty of Science and Engineering, Waseda University, Japan. He received his Ph.D., M.A. and B.A. in Human Sciences from Waseda University in 1998, 1995 and 1993, respectively. His research interests include ergonomics and human factors in advanced imaging technologies such as stereoscopic imaging, virtual / augmented / mixed reality and cross-modal systems. He is a Certified Professional Ergonomist (CPE).

Bjorn Sommer is a Research Tutor at the Royal College of Art (London) where he is leading Year One of the Innovation Design Engineering program. He is working on Immersive Analytics of collective behaviour as well as mesoscopic and molecular data modelling and visualization. He has experience since more than a decade in the development of 3D-stereoscopic applications. He holds a B. Sc. in Media Informatics, an M.A. in Interdisciplinary Media Sciences, and a PhD in Bioinformatics from Bielefeld University. From 2015-2016 he was working as a Research Fellow at Monash University (Melbourne), and from 2016-2019 at the University of Konstanz.