

Stereoscopic Displays and Applications XXVIII - Introduction

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Abstract

This document provides an overview of the 2017 Stereoscopic Displays and Applications conference (the 28th in the series) and an introduction to the conference proceedings.

Introduction

The 28th annual Stereoscopic Displays and Applications (SD&A) conference was held from January 30 – February 1, 2017, in Burlingame, California, at the Hyatt Regency San Francisco Airport Hotel. The SD&A conference remains the premier venue for the dissemination of research on topics relating to stereoscopic displays and their applications.

SD&A attracts key players in the field: stereoscopic experts from industry and academia presented the two keynotes, participated on the discussion panel, and spoke in the technical presentations. The conference had an excellent technical program covering a wide range of stereoscopic topics.

This year, the conference received 40 submissions. Of these, 33 were accepted for oral presentation (82%), with an additional two interactive presentations accepted as posters. Two of the conference sessions were jointly held with co-located conferences: the Human Vision and Electronic Imaging 2017 conference and a special-topic session on Visualization Facilities with our colleagues of The Engineering Reality of Virtual Reality 2017 conference.

Of note, three of the conference manuscripts have been published in the IS&T Journal of Imaging Science and Technology (JIST) via the "JIST-First" presentation option introduced in 2016. The conference program listing at www.stereoscopic.org/2017 indicates which presentations were presentation only and which have a supporting manuscript and where to find it. All manuscripts from the SD&A 2017 conference are open access – happy reading!

This introduction gives an overview of the conference as a reminder for those who attended and an insight into what happened for those who were unable to attend.

First Day

The first day had two technical sessions. Topics covered included Stereoscopic Human Factors and Applications and a first of two sessions on Autostereoscopic Displays. The day also included the Electronic Imaging (EI) Symposium Opening Plenary, as well as the first SD&A Keynote session of the conference. Keeping with the conference's tradition of a busy Monday, the day also included the EI Symposium reception, the annual SD&A 3D Theater Session, and the ritual SD&A conference banquet at a nearby restaurant.

The Monday EI Plenary was presented by Prof. Laura Waller of U.C. Berkeley, with the title "Giga-scale 3D computational

microscopy" on the topic of computational imaging as applied to medical microscopy. In a fascinating talk, Prof. Waller described her lab's co-development of software and optical tools to obtain high-resolution images of biological samples with variable focus. As in previous years, the EI Plenary was given in the large conference room that was the "home base" for the SD&A Conference. The video of Prof. Waller's presentation is available here: <http://bit.ly/2oaJmIF>

The first SD&A Keynote Presentation was given by David Chavez, CTO of zSpace, Inc. (Sunnyvale, CA) and was entitled, "Stereoscopic displays, tracking, interaction, education, and the web." zSpace is a silicon valley based technology company which has developed a unique stereoscopic display system that includes head and stylus tracking and a suite of software aimed at the educational sector. The presentation was a very well-received, generating much conversation for the remainder of the conference.

The 3D Theater Session is a regular highlight of the conference that showcases 3D content from around the world. This year, the following 31 pieces (or segments thereof) were screened:

Competition Category:

1. "Anisomatropia (aka Segovia All Over Ya)" – Chris Casady (USA)
2. "BoooM" – Alonso Benavente Fortes (Canada, Peru, Ecuador)
3. "Chrysalis" – Ina Conradi and Mark Chavez (Singapore)
4. "From Great Depths 3D – Witnessing the Wrecks of HMAS Sydney II and HSK Kormoran" – Western Australian Museum and Curtin University (Australia)
5. "Half & Half" – John Hart (USA)
6. "Hidden Worlds in 3D" – Robert Bloomberg (USA)
7. "Little Red Dot" – Chanel Samson (USA)
8. "Lost Memories" – Volker Kuchelmeister (Australia)
9. "Microscapes" – John Hart (USA)
10. "Mind the Gap" – Karel Bata (UK)
11. "Mower Minions" – Bruno Chauffard and Glenn McCoy (USA)
12. "Reggae Temple 2015" – Fabien Remblier (France)
13. "Sing China 2016" – Percy Fung (China)
14. "Tenderness" – Waclaw Miklaszewski (Poland)
15. "Terracotta Warriors 3D" – Percy Fung (China)
16. "The First Stars" – Ralf Kaehler and Tom Abel (KIPAC/SLAC) (USA)
17. "The Simple Carnival – Smitten" – Jeff Boller (USA)
18. "Through Worlds and Meanings" – Aleksey Osipenkov (Russia)
19. "'Until Jesse 3D' with Technical Voiceover" – Miriam Ross, Aaron Lewis, Rebecca Stuart, Morgan Fowler, Steph Miller, Henry Bennison, Paul Wolffram, and Neil Dodgson (New Zealand)
20. "3Dece Mirrors" – Franklin Londin (USA)

Demonstration Category:

1. "Cinema Bonus Card" – Giorgi Tavartkiladze and Elia Pharsadanishvili (Georgia)
2. "Finding Dory" – Pixar Animation Studios (USA)
3. "Habitus" – Peter Rose (USA)
4. "Harmony Lane (from 1954)" – 3-D Film Archive, LLC (UK)
5. "Journey to Space" – Giant Screen Films and K2 Communications (USA)
6. "Piper" – Pixar Animation Studios (USA)
7. "September Storm (from 1960)" – 3-D Film Archive, LLC (USA)
8. "Some Stereo Drawing Machines" – Sylvain Arnoux (France)
9. "The Adventures of Sam Space (from 1955)" – 3-D Film Archive, LLC (USA)
10. "The Good Dinosaur" – Pixar Animation Studios (USA)
11. "The Holland Biunnel" – Peter Rose (USA)

All entries were screened in high-quality polarized 3D on the conference's large projection screen.

The Best of Show awards were judged by:

- Emeritus Professor Dan Sandin of the Electronic Visualization Lab at Univ. Illinois at Chicago, who worked on the original vector graphics for Star Wars: A New Hope,
- Eric Kurland of 3-D Space, who has worked on 3D productions for Fox and OK GO, and
- Chris Ward, CEO of Lightspeed Design Group and DepthQ Stereoscopic, developer of 3D cinema solutions deployed worldwide.

The judges chose the following 3D content winners:

Best-of-Show Live Action category:

"From Great Depths 3D – Witnessing the Wrecks of HMAS Sydney II and HSK Kormoran" from Western Australian Museum and Curtin University (Australia)

Synopsis: Long considered one of the world's most significant wartime mysteries, the fateful dusk encounter between HMAS Sydney (II) and the German raider HSK Kormoran stands as Australia's single largest naval disaster. The loss of both ships on the night of 19 November 1941 with Sydney's full war complement of men and boys sparked a growing mystery spanning sixty-six years for Australia's most famous fighting ship and for one of Germany's best known raiders. This film explores the wreck sites of both ships. (See Figure 1)



Figure 1. 'B' Turret on the wreck of HMAS Sydney (II) from "From Great Depths 3D"

Best-of-Show Animation category:

"Chrysalis" from Ina Conradi and Mark Chavez (Singapore)

Synopsis: Chrysalis is a tale of personal struggles and endurance. The film is based on an old legend about the butterfly's struggles to evolve. (See Figure 2)

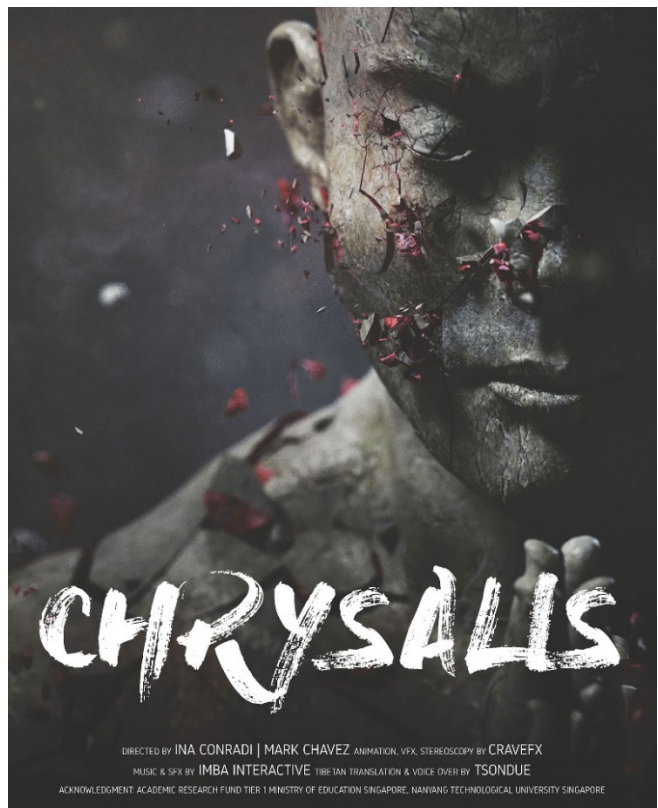


Figure 2. Promotional poster for "Chrysalis" by Ina Conradi and Mark Chavez

The producers of the 2017 SD&A 3D Theater were John Stern (Intuitive Surgical Inc., retired), Chris Ward (Lightspeed Design), and Andrew Woods (Curtin University). Management and playback of 3D content was expertly handled by Dan Lawrence (Lightspeed Design). The 3D content partners for the

session were the LA 3-D Movie Festival (USA) and the 3-D Film Archive (USA).

The evening concluded with the SD&A conference dinner at Max's Restaurant and Bar in Burlingame - a short walk from the conference hotel. The conference dinner is always a fun and relaxed opportunity to socialize with one's peers. The 2017 dinner ran late into the night and not without attendees producing stereoscopic viewers, panoramic cameras, and other 3D gear at the dinner tables.

Second Day

The second day of the conference had three technical sessions: Human Vision and Stereoscopic Imaging, a second Autostereoscopic Displays session, and Stereo-cameras and Stereo-matching. The day also included the second Symposium Plenary, the popular annual SD&A Discussion Forum, and the annual demonstration session.

The second EI Plenary was presented by Asst. Prof. Gordon Wetzstein of Stanford University. Dr. Wetzstein leads the Stanford Computational Imaging Group, and specializes in the development of systems at the intersection of optics, software, and imaging and display, particularly in the generation and sensing of light fields. Dr. Wetzstein gave a wonderfully detailed yet accessible overview of several advances in computational imaging, such as multi-layer 3D displays and VR headsets with focus cues. In an unexpected treat, Dr. Wetzstein invited the symposium attendees to a special open house at his lab at Stanford University on the Friday following the symposium to see student projects and equipment demonstrations of many of the topics discussed during his presentation. A video of Dr. Wetzstein's presentation is available here: <http://bit.ly/2oybQIP>

The discussion forum, led by conference co-chair Nick Holliman, explored the topic of "AR, VR and MR: will they become the mass market for stereoscopic imaging?" with participants Kurt Hoffmeister (Mechdyne) and Dave Cook (NVIDIA). The panel's discussion ranged over the full range of topics relating to AR, VR and MR, from technology to human factors issues. A detailed consideration of the latest graphics hardware included how specific support for low latency rendering in the graphics pipeline has become a key part of making the headset experience comfortable for a wide audience. In addition, the challenge of addressing the physiological mismatch between the visual and vestibular systems in VR was also discussed. Solutions described included adjusting gameplay so that players are guided, or teleported around environments, inducing physical motion of players to stimulate the vestibular system at key points in an experience and finally the potential of building electro-magnetic stimulation for the vestibular system into headphones to simulate motion effects.

On Tuesday evening, participants eagerly attended the annual symposium-wide demonstration session, which included many SD&A participants. Demonstrations relevant to SD&A topics included:

- "Volume" - a volumetric display from Looking Glass Factory (Shawn Frayne)
- "The NEW" 3D Map software (Stephan Keith and Andrew Woods)

- The zSpace 300 display and associated 3D software from zSpace Inc (David Chavez and Elizabeth Lytle)
- Space Map running on a zSpace 3D display (Björn Sommer)
- The GoPro Omni and Odyssey multi-camera 360 rigs (Andrew Ganzon and Tim MacMillan)
- Eric Kurland was also seen walking the exhibits with his Ricoh Theta stereo-pair and a Samsung Gear VR headset

A good number of demonstrations from authors presenting at other Electronic Imaging conferences were also on display. A selection of photographs from the demonstration session will be available via the SD&A conference website www.stereoscopic.org

Third Day

The third day of the SD&A conference had the second SD&A keynote, the third EI plenary, and three technical sessions: Stereoscopic Image Quality, 3D Developments, and a very informative joint session on Visualization Facilities.

The Wednesday SD&A Keynote speaker was Tim MacMillan (consultant), whose presentation, developed with David Newman (GoPro, Inc.), showed the history of their "time-slice" multi-camera rigs. While a graduate student, Tim began developing systems comprised of numerous cameras that captured a scene from multiple points of view. His explorations continued for decades, in pursuit of a camera technology as agile as those portrayed in video games such as Tomb Raider.

Mid-day, Brian Cabral (Director of Engineering, Facebook, Inc.) shared the process that Facebook carried out to develop their open-source 3D-360 video capture system, Surround 360. Facebook's 360 ecosystem comprises hardware and software systems and combines a range of technologies including computer vision, CMOS sensors, color science, photogrammetry, optics, and computer graphics. "The hardware is the easy part" he explained – "stitching all of the images is hard". Cabral's presentation was recorded and can be viewed here: <http://bit.ly/2ngMGHa>

The SD&A conference was rounded out by a very special Joint Session on the topic of visualization facilities. The nuts-and-bolts of VR and other immersive large display systems around the world were presented by folks from: Newcastle University, the Electronic Visualisation Laboratory (EVL) at University of Illinois at Chicago, Indiana University, University of California San Diego (UCSD), Monash University, the University of Konstanz, Curtin University, and the University of Western Australia.

The day concluded with the interactive paper / poster session. There was lots of energy in the hall with presenting authors standing with their posters and kept busy with questions from the attendees. A particular feature of the 2017 symposium was A Showcase of Student and Young Professionals' Research. Over popcorn and drinks, colleagues chatted the night away, and even had an opportunity to play stereoscopic video games on a vintage Vectrex with the Vectrex 3D Imager stereoscopic accessory, kindly brought all the way from New York by first-time attendee Ilicia Benoit.

Discussion

Video recording was made of most technical sessions in the SD&A conference hall including the two SD&A keynotes. The content is available online via the SD&A conference website and a special SD&A 2017 YouTube playlist: <http://bit.ly/SDnA2017videos>

In addition to the prizes for the 3D Theater, a final prize was offered at the conference for the best use of stereoscopic presentation tools during the technical presentations - chosen by the SD&A conference chairs.

The winner for the best use of the stereoscopic projection tools during the SD&A conference presentations was:

“Estimation of altitude in stereoscopic-3D versus 2D real-world scenes”

Lesley Deas¹, Robert Allison¹, Brittney Hartle¹, Elizabeth Irving², Mackenzie Glaholt³, and Laurie Wilcox¹
(1: York University, 2: University of Waterloo, and 3: Defence Research and Development Canada (Canada))

The prizes this year were copies of various Disney Pixar Blu-ray 3D discs. Congratulations to all our prize-winners.

Many individuals and companies contributed in various ways to the success of this year’s SD&A conference:

- We appreciate the support of this year’s stereoscopic projection sponsors: DepthQ Stereoscopic (USA), Christie Digital (USA). The ability to present high-quality large-screen stereoscopic images and video at the conference is vital to the success of the conference.
- This year we had a Christie Digital Mirage HD10K-M projector (1920 × 1080 resolution, 16:9 aspect ratio, 3 chip DLP, 10,000 ANSI lumens, provided by Christie Digital) projecting onto a 4.9 × 2.7 meter silvered screen (provided by STRONG / MDI Screen Systems), outputting frame-sequential circularly-polarized 3D (at 120Hz) by way of a DepthQ active polarization modulator (provided by Lightspeed Design). The system was driven by a DepthQ stereoscopic media server for playback of all of the stereoscopic video content shown during the 3D Theater.
- Many thanks to the individuals who worked on-site: Adrian Romero and staff from Spectrum Audio Visual; Chris Ward and Dan Lawrence from Lightspeed Design.
- We very much appreciate the dedicated support of Stephan R. Keith (SRK Graphics Research), who again had a multi-tasked role at this conference, including supporting the needs of all of our presenters.
- Max Anderson, a student at the Art Institute of California – San Francisco, provided additional support by tracking author video recording permissions.
- 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.
- Arnott's Australia, whose Tim Tam biscuit (cookie) products enable SD&A to provide the best ice-breaker activities than any other technical conference across the globe.
- Thanks to the demonstration session presenters for bringing equipment to show – especially to the presenters who brought equipment from overseas.

- 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, Davide Gadia, Hideki Kakeya, Stephan Keith, Michael Klug, John Stern, and Chris Ward. In 2017, we welcomed new committee member Bjorn Sömmer, of the University of Konstanz (Germany).
- Thanks also to the staff at IS&T - the organizing society instrumental in organizing all manner of aspects for the meeting.
- Most importantly, we thank the conference authors and attendees, who ultimately made this meeting such a successful event. Thanks especially to those who travel a long way to join us each year.

Before wrapping up, there is one last item we’d like to discuss and that is SD&A citations formats. We’ve previously reported on the pleasingly high rate of citations that manuscripts from the SD&A conference receive.^{[2][3]} We used special tools to harvest Google Scholar to obtain this data, and with the 2016 and 2017 proceedings being open access, this is sure to help accelerate citations. The specific aspect we wish to comment on here is the varying methods by which manuscripts published in the Stereoscopic Displays and Applications conference proceedings are cited. There are numerous citation styles in common use, including APA, MLA, Chicago, Harvard. In most cases, when a proceedings manuscript is cited, it includes listing of: the authors, the manuscript title, the title of the proceedings, the year, and perhaps some other details. Unfortunately we have seen some papers cite SD&A manuscripts in a way that lists the volume number but doesn’t actually mention the actual title of the SD&A conference. This is a great loss, since readers will likely miss that the cited manuscript was presented at the Stereoscopic Displays and Applications conference. To help authors cite manuscripts from the SD&A proceedings series in a common way, and in a way that appropriately cites the conference, we have prepared a detailed listing of all 28 Stereoscopic Displays and Applications conferences with a suggested citation format. These citations can be adapted to meet the specific citation style requirements of a particular journal (e.g. initials before or after surname, year near the front or the end of the citation, etc) however fundamentally, it would be helpful, for the reader, and the conference, if the name of the SD&A proceedings volume was included in the citation. As well as the incrementing roman numerals in the conference title, the name of the SD&A proceedings has also changed at some points in the history of SD&A. From 1990 to 1993 the proceedings name was the same as the conference name.^{[4][5][6][7]} From 1994 to 2007 the manuscripts from the SD&A conference were co-published manuscripts from the Engineering Reality of Virtual Reality conference in a volume titled “Stereoscopic Displays and Virtual Reality Systems”.^{[8][9][10][11][12][13][14][15][16][17][18][19][20][21]} From 2008 the proceedings name was again the same as the conference name – with each conference/proceedings numbered in sequence using roman numerals.^{[22][23][24][25][26][27][28][29][30][31]} The list of citation formats helps authors to list the SD&A proceedings and conference title correctly when they are citing the proceedings or its manuscripts. Please refer to the list in Appendix 1.

In 2016 we lost our dear friend Vivian Walworth – long-term colleague and SD&A committee member from 2000 to 2015. She

offered so much to our conference, the world of stereoscopic imaging, women's rights and much more. We are glad that she was able to deliver one of our prestigious SD&A Keynote presentations in 2013. The video of her presentation is available online: <http://zeeba.tv/history-of-polarized-image-stereoscopic-display-8648-80/> There is also an article about her life in the Journal of Imaging Science and Technology (JIST).^[1] We dedicate this proceedings volume to Vivian.

Conclusion

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 2018 conference, with a deadline in mid-2017 – see the SD&A website www.stereoscopic.org for details and deadlines. The website 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 runs an active LinkedIn group which is available at:

www.linkedin.com/groups?gid=1945944

LinkedIn has recently been reducing its email notification options so if you're not a regular user of LinkedIn and you would like to be kept up-to-date with SD&A conference activities via email, it will probably be better for you to sign-up to our conference mailing list. Visit here to sign up:

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

The conference was live-Tweeted by @SDnAconf and other attendees. Check out the conference Twitter feed for details:

<https://twitter.com/SDnAconf>

Photographs from this year's conference are available in a special album on Flickr:

<https://flic.kr/s/aHskSFJHZs>

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

Next year, the 29th annual SD&A conference will be held during the period of January 28 – February 1, 2018, again at the Hyatt Regency San Francisco Airport hotel in Burlingame - within sight of the SFO airport. The hotel provides super convenient access from the airport with a free regular shuttle. This is the same venue where the conference was held 2011 to 2013 except that the hotel has recently completed on a multimillion-dollar renovation. The open internal atrium of the hotel is an iconic and picturesque aspect of the venue.

The 2018 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 2018 event. We hope to see you there!

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Author Biographies

Andrew Woods is Manager of the HIVE Visualisation Facility and a Research Engineer at the Centre for Marine Science & Technology - both at Curtin University. His research interests are in stereoscopic 3D imaging, visualisation, 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.

Nick Holliman researches 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 Principal Member Technical Staff at Draper (Cambridge, MA, USA) in the Division of Positioning, Navigation and Timing. 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).

Appendix 1: Stereoscopic Displays and Applications conference proceedings recommended citation formats

1990:

Cite a Manuscript - Short Form:

Author(s), "Title of Paper," in *Stereoscopic Displays and Applications*, Proceedings of IS&T-SPIE Electronic Imaging, SPIE Vol. 1256, page numbers (1990).

Cite a Manuscript - Long Form:

Author(s), "Title of Paper," in *Stereoscopic Displays and Applications*, edited by John O. Merritt, Scott S. Fisher, Proceedings of IS&T-SPIE Electronic Imaging, SPIE Vol. 1256, page numbers (1990).

Cite the Full Proceedings:

John O. Merritt, Scott S. Fisher (eds), "Stereoscopic Displays and Applications," Proceedings of IS&T-SPIE Electronic Imaging, SPIE Vol. 1256 (1990).

1991:

Cite a Manuscript - Short Form:

Author(s), "Title of Paper," in *Stereoscopic Displays and Applications II*, Proceedings of IS&T-SPIE Electronic Imaging, SPIE Vol. 1457, page numbers (1991).

Cite a Manuscript - Long Form:

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