30 Years of the Stereoscopic Displays and Applications conference - Milestones and Statistics

Andrew J. Woods[1], Nicolas S. Holliman[2]
[1]Curtin University, Australia; [2]Newcastle University, United Kingdom.

Abstract

The inaugural Stereoscopic Displays and Applications (SD&A) conference was held in February 1990 at the Santa Clara Convention Centre in Silicon Valley, California. For the past 30 years the SD&A conference has been held every year in the San Francisco Bay Area, up and down the San Francisco Peninsula, and over that period has brought together researchers from across a broad range of disciplines, and from locations world-wide, to report on their contributions to advancements in the field of stereoscopic imaging. The conference has supported a large community of researchers over time who have collectively presented and published a wealth of global knowledge in this subject area. In this paper we look at the impact of the conference in its first 30 years through an analysis of the conference's published papers and an analysis of the citations of those papers. We also review some actions that conference organizers can take to help build communities of knowledge around conferences.

Introduction

The annual Stereoscopic Displays and Applications (SD&A) conference reached its 30th year in 2019 – a milestone well worth celebrating! The stereoscopic displays landscape was very different 30 years ago and the SD&A conference has overseen and facilitated huge changes over that period. When the SD&A conference started back in 1990, the Cathode Ray Tube (CRT) display was the dominant display type for computers and home television, and over the past 30 years the common display technology has changed from CRT to Plasma, to Liquid Crystal Display (LCD), and more recently is transitioning to Organic Light Emitting Diode (OLED). Projection displays have also changed from CRT, to LCD and Digital Micro-mirror Device (DMD) / Digital Light Processing (DLP). Due to the hard work of many hard-working engineers and scientists, all of these display technologies have been able to support stereoscopic display options. The 3DTV boom which peaked in around 2014 was a hard-to-imagine distant dream back in 1990.

A huge number of innovations have occurred is all aspects of stereoscopic imaging over that 30 year period, from capture to display, to processing and perception. Massive technical developments have occurred in stereoscopic software, stereoscopic computer graphics, autostereoscopic and volumetric displays, 3D cinema, and many other areas. Our understanding of the human visual system has also improved, allowing us to increase the quality of 3D content. Stereoscopic 3D imaging is also proving its value in a wide range of application areas from consumer entertainment to industrial and commercial uses such as medical imaging.

The SD&A conference has facilitated the development of a community of researchers, academics, consultants, and business leaders, and provided a venue for them to share information and ideas on stereoscopic imaging topics, develop collaborative opportunities, and learn about advancements in the field. Over a 30 year period, the SD&A conference has had a huge impact serving the stereoscopic imaging community.

It is hard to objectively measure the impact and value of a conference, but one of the most common ways is to measure the impact of published proceedings, which in turn is usually measured by counting the citations of the conference's published manuscripts and calculating citation statistics. A paper receives one citation count when another paper cites it in its references section. The number of citations that a paper receives is an indicator of the importance and impact of a particular paper. Calculating citation statistics used to be a complicated process but now tools such as Google Scholar make that process much easier.

In this paper we explore the history of the SD&A conference through its citation statistics and other statistics.

Methodology

Google Scholar has a new feature allowing groups (such as research laboratories, companies, and conferences such as SD&A) to collate their citation statistics. Andrew Woods and Nick Holliman added every SD&A paper from 1990-2018 to a Google Scholar Profile specifically set up for the SD&A conference. Now that the historical papers have been added to the profile, Google Scholar automatically collates citations and calculates citation metrics on a regular and ongoing basis. The only update that is needed each year is for new SD&A papers to be added to the profile after each conference.

The SD&A Google Scholar profile is located here: https://scholar.google.com/citations?hl=en&user=lYYx0xsAAAAJ

The profile lists every published paper of the SD&A conference and indicates the citation count for each paper. A detailed listing of the papers the citations have come from can be accessed by clicking the appropriate citation count link. The profile also calculates citation metrics.

Although this paper coincides with the 30th annual SD&A conference, due to the timing, it necessarily does not include statistics from the 30th annual conference since this paper is being published with those papers. For some of the statistics, the results for 2017 and 2018 are not included because there has been insufficient time for papers from those conferences to gain a meaningful number of citations due to the inherent delay in publishing academic manuscripts.

A similar analysis was last performed in 2013 [1], and in 2014 [2] for the 25th anniversary of SD&A. At that time the analysis was performed using two methods – using the 'Publish or Perish' program by Harzing [3], and a custom script which data-mined Google Scholar to extract the citation data for every SD&A paper developed by Joshua Hollick at the Curtin University HIVE.

Now that Google Scholar allows non-individual profiles to be created, what was once a manual and time-consuming process is now easily repeatable and updated, once the initial setup is performed.

Citation Statistics

There have been 1504 published manuscripts (papers) in the SD&A conference proceedings over the period 1990-2018. As of 13 January 2019, there were a total of 21040 citations across all of those papers [4]. In 2014, the total citation count was calculated as 12681 [2] – an increase of 66% in just 5 years. The SD&A proceedings has an average of 14 citations per paper.

The total number of citations received by papers from each SD&A proceedings volume year is shown in Figure 1. Apart from the peak at 2004, the number of citations per conference proceedings year is fairly level – with a mean citation count per volume of approximately 800 – over the period 1990-2011. The drop on the right hand side of the graph is expected because it usually takes many years for published papers to accumulate a significant number of citations.
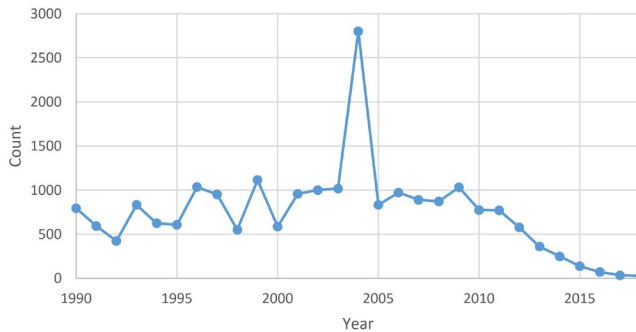

Figure 1: Total citation counts for papers in each SD&A proceedings volume year.

The citation data also allows us to examine the popularity and impact of individual papers and authors as is discussed in the following sections.

Highest Cited Paper Each Conference Year

The highest cited paper for each year of SD&A over the period 1990-2016 is listed in Table 1. These results highlight an incredible variety of topics over the history of the conference.

The highest cited paper in the very first year of SD&A is a very significant paper titled "Autostereogram" by Christopher Tyler and Maureen Clarke. This paper introduced to the world the novel technique of encoding a stereoscopic 3D depth-image into single printed random-dot image, which became internationally famous as the Magic Eye books and posters – known for confusing people world-wide with the taxing eye-acrobatics required to pull out the hidden 3D image. The first page of that significant paper is shown in Figure 1. One of the very first published autostereograms is shown in Figure 2, and Christopher Tyler is pictured in Figure 3.
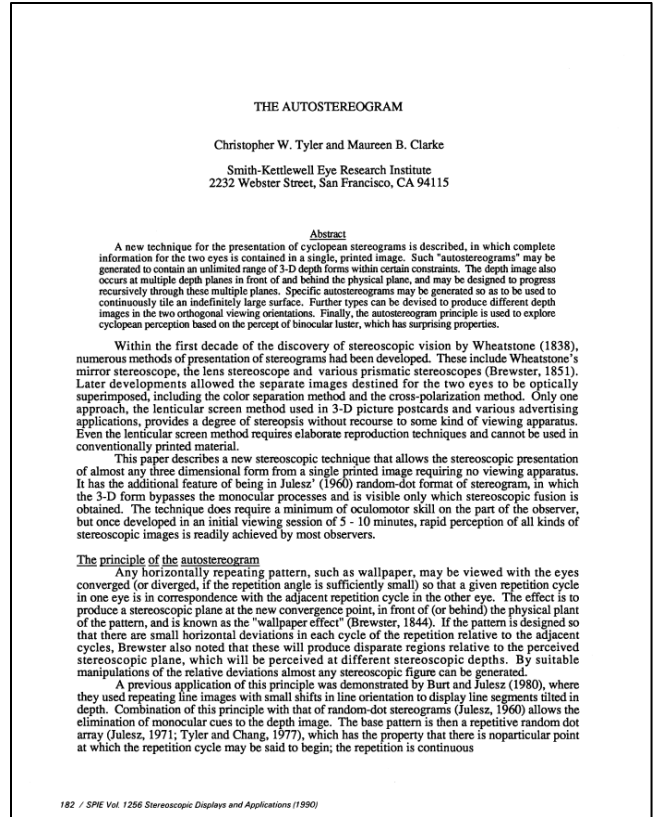

Figure 2: First page of "Autostereogram" by Christopher Tyler – highest cited paper from the first SD&A conference. [5]
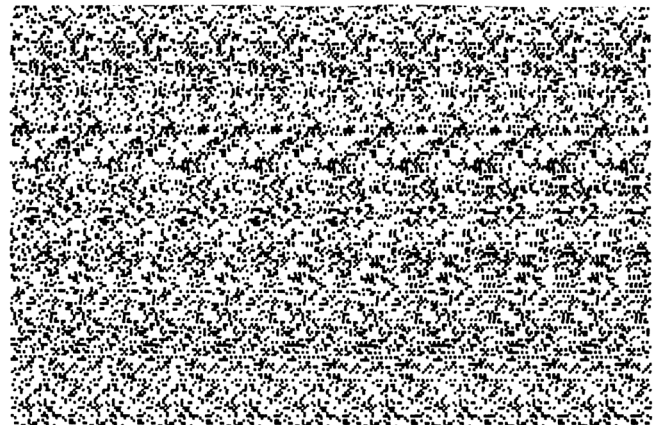

Figure 3: One of the first published autostereograms – showing the word 'ZAP'. Reproduced from Figure 2 of reference [5].

Figure 4: (L-R) Christopher Tyler, Bernice Rogowitz, Thrasos Pappas and John Merritt at the 2008 Electronic Imaging Symposium.

There is a wide range of authors, organizations, and countries represented in the results. Interestingly there are several cases of the same author appearing twice in the list, with David Drascic, Paul Milgram, Cees van Berkel, Wa James Tam, Dmitry Vatolin, David Ezra, as well as this paper's authors: Andrew Woods, and Nick Holliman. This not only indicates that these authors have presented multiple times at the conference, but also their work is of keen interest to other actively publishing authors.

Top 20 papers

Another interesting analysis is to look at the top 20 cited papers from the SD&A proceedings series – which are listed in Table 2.

The most highly cited paper across the entire publishing history of SD&A is from the 2004 SD&A conference – namely "Depth-image-based rendering (DIBR), compression, and transmission for a new approach on 3D-TV" [6] by Christoph Fehn from the Fraunhofer Institute for Telecommunications at the Heinrich Hertz Institute (HHI) in Germany. The paper discussed a technique for broadcasting stereoscopic content that would be backward compatible with the existing 2D digital television framework, by the broadcast of a depth-map along with an existing 2D view.

Interestingly three other papers from the 2004 SD&A conference also appear in the top 20 listing. It was obviously a very productive year.

The most common topic in the top 20 is autostereoscopic and volumetric displays and indeed this has been an ongoing field of interest for many researchers over the history of the conference. Other topics of interest represented in the top 20 are stereoscopic image quality, stereoscopic image compression, and stereoscopic image geometry.

Analysis Graphs

Over time the number of citations to SD&A papers has steadily increased, the total number of citations is shown in Figure 5. In addition, the total number of citations due to each year's papers is shown. This gives a visual impression of the activity in the field each year. Note that the 2004 peak is overly influenced by a single paper, and as we get closer to the current day there is a natural drop off in citation as these papers have not been citable for as long.

Figure 6 illustrates the top 15 authors by the citation counts to their collective outputs over the whole history of the conference. This is sorted from top to bottom by citation count.
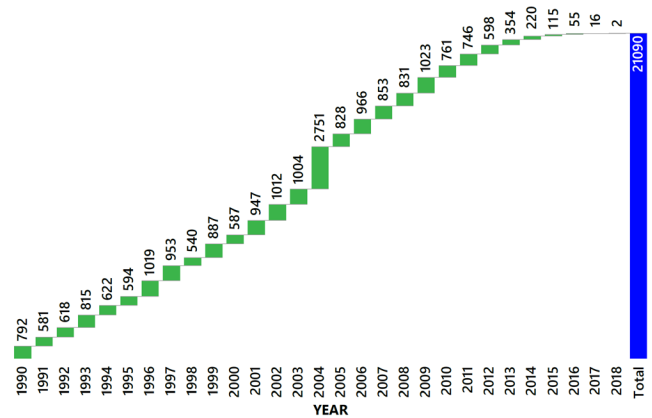

Figure 5: This graph shows the total number of citations of all papers published at the SD&A conference, separated by the publication year of the papers. Clearly the more recent years will have had less time over which to accumulate citations.
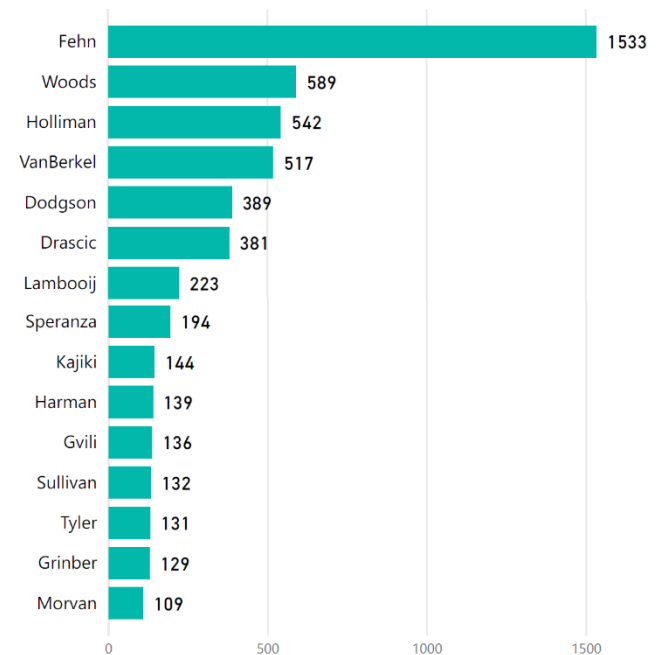

Figure 6: This graph shows the top 15 most cited authors by total citation count over the lifetime of the SD&A conference. The results are sorted from top to bottom by total citation count across all papers by that author.

h-index Comparison

The h-index is a metric used to indicate the productivity and citation impact of the publications of an author or publication outlet. The h-index is calculated based on a set of most cited papers and the number of citations that they have received in other publications. The h-index is defined as the largest number 'h' such that at least 'h' publications have at least 'h' citations. The h-index is a non-linear measure in that as the h-index increases, increasingly more citations are needed to increment to the next h-index value.

The h5-index is a refinement of the h-index limited to citations received in the last 5 years.

In the past it has been hard to calculate the h-index for the SD&A conference because the SD&A proceedings papers were

published across multiple volumes, and additionally with select papers being published in affiliated journals. For SD&A, it is necessary to track citations at the individual manuscript level and Google Scholar now allows us to do that easily.

Table 3 lists the calculated h5-index and h-index for the SD&A conference proceedings, and also for a selection of journals in the imaging and displays field. It can be seen that the SD&A proceedings is performing extremely well against these publications. On the h5-index values, SD&A matches the performance of Optical Engineering and outperforms all of the other listed journals which is incredibly impressive given SD&A publishes on a much narrower range of topics than any of the listed journals. On the h-index comparison, SD&A outperforms all except one of the journals (OE).

Table 3: *Comparison of h-index figures for various publications in the field of electronic imaging and displays. *1 as of April 2019 via Google Scholar. *2 as of April 2019 via Google Scholar Metrics. *3 as of April 2019 via www.scimagojr.com. (OE = (Journal of) Optical Engineering, JDT = Journal of Displays Technology, JEI = Journal of Electronic Imaging, JSID = Journal of the Society for Information Display, JIST = Journal of Imaging Science and Technology).*

Publication	h5-index (2019)	h-index (2019)
SD&A	33 *1	62 *1
OE	33 *2	89 *3
JDT	28 *2	53 *3
JEI	23 *2	57 *3
Displays	21 *2	49 *3
JSID	15 *2	43 *3
JIST	9 *2	39 *3

Publication Download Statistics

SPIE and IS&T have kindly provided the download statistics for all papers published on their respective digital library platforms for the period up to February 2019. The SPIE Digital Library (SPIEDL) platform commenced in 2004 and from that date forward all published papers were immediately available on that platform. A multi-year process subsequently commenced to digitize the back-catalog of printed proceedings volumes. For SD&A this process was accelerated because the back-catalog of SD&A proceedings volumes had already been digitized when the "Selected SPIE papers on CD-ROM: Stereoscopic Displays and Applications" volume was produced in 2000.

In 2016, IS&T became the sole organizing society of the Electronic Imaging Symposium and since that time all Electronic Symposium conference proceedings papers have been published on the IS&T Digital Library which is hosted by Ingenta Connect. All Electronic Imaging Symposium papers (including SD&A) have been free and open access since that time.

The download statistics are listed in Table 4 and illustrated in Figure 7. The figures show that year with the peak of 'download' interest is 2012 which roughly occurs during the peak of the 3DTV market. The current dataset has download counts grouped for each year of proceedings so it's not possible to see which particular paper(s) garnered the most interest. Interestingly the trends and shape of this graph are very different to the citation counts graph shown in Figure 1 – necessarily because they show different things.

Eric Pepper, publications manager at SPIE wrote [7]: "You will likely want to know how these numbers compare to the other EI proceedings and to other SPIE conferences overall. Downloads for SD&A are about 1.6× of EI overall. I am not surprised by this. Usage for other SPIE content varies by technology. Some are quite

a bit greater and some less. Based on this analysis and from other stats I have seen, I'd say that SD&A usage is easily in the top half of the areas we cover."

Table 4: *Number of downloads of papers from the proceedings of each conference year from the respective online repository up until February 2019. Key: A and B = papers hosted on the SPIE Digital Library (SPIEDL) (A = pre-SPIEDL, B = post-SPIEDL, C = papers hosted open access on the IS&T Digital Library. * Publications from recent years will not have had sufficient time for the download count to be significant.*

| Year	Conference Name	Volume #	Total Downloads
1990 A	SD&A	1256	1,354
1991 A	SD&A II	1457	1,256
1992 A	SD&A III	1669	1,071
1993 A	SD&A IV	1915	1,034
1994 A	SD&A V	2177	1,781
1995 A	SD&A VI	2409	1,487
1996 A	SD&A VII	2653	3,171
1997 A	SD&A VIII	3012	3,127
1998 A	SD&A IX	3295	2,067
1999 A	SD&A X	3639	2,913
2000 A	SD&A XI	3957	2,516
2001 A	SD&A XII	4297	4,865
2002 A	SD&A XIII	4660	4,190
2003 A	SD&A XIV	5006	4,850
2004 B	SD&A XV	5291	7,513
2005 B	SD&A XVI	5664	5,626
2006 B	SD&A XVII	6055	5,609
2007 B	SD&A XVIII	6490	5,950
2008 B	SD&A XIX	6803	6,534
2009 B	SD&A XX	7237	7,724
2010 B	SD&A XXI	7524	8,647
2011 B	SD&A XXII	7863	9,434
2012 B	SD&A XXIII	8288	10,557
2013 B	SD&A XXIV	8648	5,871
2014 B	SD&A XXV	9011	5,581
2015 B	SD&A XXVI	9391	5,061
2016 C	SD&A XXVII	IS&T EI 2016	2,976 *
2017 C	SD&A XXVIII	IS&T EI 2017	1,201 *
2018 C	SD&A XXIX	IS&T EI 2018	323 *
TOTAL:			**124,289**
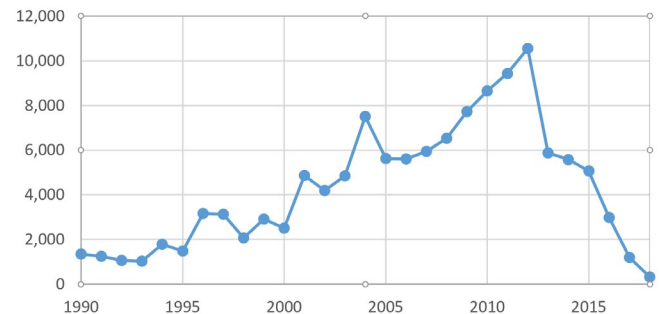
Figure 7: *Downloads of papers for each SD&A proceedings year from the respective official download site.*

SD&A Video Recordings Statistics

Select sessions of the SD&A conference have been video recorded as far back as the 20007 conference.

Over the period May 2014 to November 2018, there has been 207,702 minutes of SD&A videos viewed on the Electronic Imaging Symposium YouTube channel https://www.youtube.com/channel/UCShYQ9u43HNmeBEcicVbbWg which is equivalent to almost six months of continuous 24/7 viewing. Additionally there have been 52,610 individual video views for that same period.

The top 20 most viewed SD&A presentation videos are listed in Table 5. The most popular video to date has been: "LEIA 3D: holographic reality" presented by David Fattal from Leia Inc. at the 2016 SD&A conference with 12,597 views (as at April 2019). https://www.youtube.com/watch?v=-I9namlza4U It was also pleasing to see display technology being recently deployed in a commercially released product – the RED Hydrogen One mobile phone – released in late 2018.

Links to playlists of select years of SD&A presentation videos are provided in Table 6.

Table 6: SD&A conference presentation videos playlist links for the various conference years.

Year	SD&A YouTube Playlist Link
2010 and earlier	www.youtube.com/playlist?list=PLoksP178KYM7s0V9rBbvO-oAN36ye-NXK
2011	www.youtube.com/playlist?list=PL0943C014A09CBB72
2012	www.youtube.com/playlist?list=PL69F40AAEC7461CE3
2013	www.youtube.com/playlist?list=PLoksP178KYM65ambZe18z6rQ21qoxLOj6
2014	www.youtube.com/playlist?list=PLoksP178KYM4GvPK86sS-oC8-RCux7ZpE
2015	www.youtube.com/playlist?list=PLoksP178KYM5jBgAeOZtarUed904swe3c
2016	www.youtube.com/playlist?list=PLoksP178KYM7FiebK3IvhvjvExr_kLSLH
2017	www.youtube.com/playlist?list=PLoksP178KYM5OZh7Bw4aSz0aXV3KK20v-
2018	www.youtube.com/playlist?list=PLoksP178KYM5CpoihupqKpcH67qARw2H2
2019	www.youtube.com/playlist?list=PLoksP178KYM7cZVUcd9TX6HDP2324jjW1

SD&A Super-Contributors

The 30th annual SD&A conference was a perfect time to recognize authors who have published multiple times at the conference – we have called them "SD&A Super-Contributors". A tally of all published authors for all published papers across all SD&A proceedings volumes up to and including 2018 was generated and sorted to reveal the number of manuscripts published by each author. The listing also reveals the organizations which have supported author presentations at the conference over many years. The listing below is ranked by the number of papers published by each author. The organization(s) that an author is from, or has been with, are also listed.

The most highly published author in the SD&A proceedings is Professor Takashi Kawai from Waseda University in Japan with an amazingly prolific 34 published papers for which he is either a primary or co-author.

7 papers:
- Robert S. Allison (York University, Canada)
- Daisuke Miyazaki (Osaka City University)
- Kjell Brunnström (Acreo and Mid Sweden University)
- Kun Wang (Acreo and Mid Sweden University)
- Zahir Y. Alpaslan (Ostendo Technologies, University of Southern California)
- Alexander A. Sawchuk (University of Southern California)
- Robert E. Cole (University of Hawaii)
- Curtis S. Ikehara (University of Hawaii)
- Davide Gadia (University of Milan)
- Sanghyun Kim (Waseda University)
- Sung-sik Kim (Samsung Electronics)
- Takafumi Koike (University of Tokyo, Hitachi)
- Ki-Chul Kwon (Chungbuk National University)
- Kuen Lee (ITRI, Taiwan)
- Katsuya Matsunaga (Kyushu University)
- Kenji Yamada (Hiroshima Institute of Technology)

8 papers:
- Dusik Park (Samsung Electronics)
- Didier Doyen (Technicolor)
- Philip V. Harmon (Dynamic Digital Depth)
- Kuo-Chung Huang (ITRI, Taiwan)
- Joohwan Kim (Seoul National University)
- Hiroyuki Morikawa (Waseda University)
- Roger Olsson (Mid Sweden University)
- Yong Man Ro (Korea Advanced Institute of Science and Technology (KAIST))
- Kazunori Shidoji (Kyushu University)
- Mehrdad Panahpour Tehrani (Nagoya University)
- Laurie M. Wilcox (York University, Canada)
- Naokazu Yokoya (Nara Institute of Science and Technology)

9 papers:
- Yong Ju Jung (Korea Advanced Institute of Science and Technology)
- Hironobu Gotoda (National Insititue of Informatics)
- Tomohiko Hattori (Nagoya University)
- Sung-Wook Min (Seoul National University)
- Takeshi Naemura (The University of Tokyo)
- Ronald Renaud (Communications Research Centre Canada)
- Kwanghoon Sohn (Yonsei University)
- Lew B. Stelmach (Communications Research Centre Canada)
- Shiro Suyama (University of Tokushima)
- Carlos Vázquez (Communications Research Centre Canada)
- Hirotsugu Yamamoto (The University of Tokushima)

10 papers:
- Marcus Barkowsky (Université de Nantes)
- Patrick Le Callet (Univ. de Nantes)
- Neil A. Dodgson (Victoria University in Wellington, Cambridge University)
- Toshio Honda (Chiba University)
- Janusz Konrad (Boston University)
- John O. Merritt (The Merritt Group)

- Serguei A. Shestak (Samsung, KIST)
- Mårten Sjöström (Mid Sweden University)

11 papers:
- Scott S. Fisher (UCSD)
- Namho Hur (ETRI)
- Hideya Takahashi (Osaka City University)
- Chao-Hsu Tsai (ITRI)

12 papers:
- Mel Siegel (Carnegie Mellon University)
- Nam Kim (Chungbuk National University)

13 papers:
- Eun-Soo Kim (Kwangwoon Univ.)
- Ian E. McDowall (Intuitive Surgical)
- Fumio Okano (NHK)

14 papers:
- Mark T. Bolas (Microsoft, UCSD)
- Masahiro Kawakita (NHK)
- Filippo Speranza (CRC Canada)

15 papers:
- Jun Arai (NHK)
- Jesse B. Eichenlaub (Dimension Technologies)

16 papers:
- Yasuhiro Takaki (Tokyo University of Agriculture and Technology)
- Jae-Hyeung Park (Inha University)
- Takashi Shibata (Tokyo University of Social Welfare)

17 papers:
- Nicolas S. Holliman (Newcastle University)
- Byoungho Lee (Seoul National University)
- Jung-Young Son (Konyang University, formerly KIST)
- Tomohiro Yendo (Nagaoka University of Technology)

19 papers:
- Hideki Kakeya (Tsukuba Univesrsity)
- Lenny Lipton (Leonardo IP, RealD, StereoGraphics)
- Masayuki Tanimoto (Nagoya University)

21 papers:
- Wa James Tam (CRC Canada)

23 papers:
- David F. McAllister (North Carolina State University)
- Andrew Woods (Curtin University)

29 papers:
- Toshiaki Fujii (Nagoya University)

34 papers:
- Takashi Kawai (Waseda University)

Discussion and Conclusion

The data presented in this paper demonstrates that the SD&A conference has had a significant impact amongst the stereoscopic imaging community over its 30 year history. We must acknowledge the contributions made by all authors who have presented at the conference, the organizations or universities that have supported them, and the many attendees who have attentively listened to many hours of presentations.

At this point it is useful to ask what makes SD&A a successful conference and whether there are any particular initiatives that have increased the impact of the SD&A conference. The conference chairs, conference committee and the organizing societies put a lot of effort into organizing the conference each year and making it a useful venue for the stereoscopic imaging community to meet and present.

Additionally, a range of other initiatives over the years have provided additional publicity and visibility for the conference – and generally make the conference a more interesting event to attend. Those initiatives include setting up the SD&A conference website www.stereoscopic.org in 1996, inviting inspiring and interesting keynote speakers to present at the conference each year, hosting a selection of photographs from each conference year on the SD&A website, video recording various conference sessions and making them available online, hosting the annual 3D Theater session which showcases 3D content from around the world, setting up the SD&A Virtual Library which hosts historical stereoscopic texts for free download, issuing press releases about various aspects of conference activities, setting up the SD&A conference Linkedin Group and running the @SDnAconf Twitter feed.

The conference website in particular has been a great advantage for the conference, providing people with a single persistent location to allow people to know about the past, present and future of the conference

The accessibility and visibility of the SD&A conference proceedings also helps authors become aware of SD&A conference manuscripts and hopefully cite them in their own publications. When the SD&A proceedings were published by SPIE (1990-2015), authors had the option to effectively make their paper(s) open access by permitting authors to host their papers on their own website. Many authors took advantage of this opportunity. Since 2016 the SD&A conference proceedings have been published fully open access which will definitely increase the accessibility and visibility of authors' work as time progresses.

Congratulations to our most highly cited authors. Congratulations to our SD&A super-contributors. Congratulations to everyone who has published and presented at SD&A and otherwise contributed to the activities of the SD&A conference over its 30 years of activity.

Lastly, don't forget to visit the SD&A conference website to find out about SD&A conference activities www.stereoscopic.org and also take the opportunity to visit the SD&A conference Google Scholar account: https://scholar.google.com/citations?hl=en&user=lYYx0xsAAAAJ

Here's to another 30 years!

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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 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.

Table 1: Highest cited SD&A papers per conference proceedings volume year over the period 1990-2016 (as at January 2019)

Year	Paper Title	Author(s) and Affiliation(s)	Cites
1990	"Autostereogram" [5]	Christopher W. Tyler, Maureen B. Clarke, Smith-Kettlewell Eye Research Institute (USA)	131
1991	"Positioning accuracy of a virtual stereographic pointer in a real stereoscopic video world" [7]	David Drascic, Paul Milgram, University of Toronto (Canada)	73
1992	"Measurement and calibration of static distortion of position data from 3D trackers" [8]	Steve T. Bryson, NASA Ames Research Ctr. (USA)	95
1993	"Image distortions in stereoscopic video systems" [9]	Andrew J. Woods, Tom Docherty, Rolf Koch, Curtin University (Australia)	589
1994	"Geometry of binocular imaging" [10]	Victor S. Grinberg, Gregg W. Podnar, Mel Siegel, Carnegie Mellon Univ. (USA)	129
1995	"Viewpoint-dependent stereoscopic display using interpolation of multiviewpoint images" [11]	Akihiro Katayama, Koichiro Tanaka, Takahiro Oshino, Hideyuki Tamura, Canon Inc. (Japan)	106
1996	"Perceptual issues in augmented reality" [12]	David Drascic, Paul Milgram, University of Toronto (Canada)	381
1997	"Characterization and optimization of 3D-LCD module design" [13]	Cees van Berkel, JA Clarke, Philips Research Labs. (United Kingdom)	207
1998	"Psychovisual aspects of viewing stereoscopic video sequences" [14]	Wa James Tam, Lew B. Stelmach, Philip J. Corriveau, CRC Canada (Canada)	82
1999	"Image preparation for 3D LCD" [15]	Cees van Berkel, Philips Research Labs. (United Kingdom)	197
2000	"Flat-panel autostereoscopic displays: characterization and enhancement" [16]	G J Woodgate, J Harrold, A M Jacobs, R R Moseley, D Ezra, Sharp Labs. of Europe Ltd. (United Kingdom)	98
2001	"Controlling perceived depth in stereoscopic images" [17]	Graham R. Jones, Delman Lee, Nicolas S. Holliman, David Ezra, Sharp Labs. of Europe Ltd. (United Kingdom)	275
2002	"Rapid 2D-to-3D conversion" [18]	P V Harman, J Flack, S Fox, M Dowley, Dynamic Digital Depth (Australia)	139
2003	"Depth keying" [19]	R Gvili, A Kaplan, E Ofek, G Yahav, 3DV Systems Ltd. (Israel)	136
2004	"Depth-image-based rendering (DIBR), compression, and transmission for a new approach on 3D-TV" [6]	Christoph Fehn, Fraunhofer-Institut fur Nachrichtentechnik (Germany)	1533
2005	"Natural 3D display with 128 directional images used for human-engineering evaluation" [20]	Hiroshi Nakanuma, Hiroyuki Kamei, Yasuhiro Takaki, Tokyo Univ. of Agriculture and Technology (Japan)	87
2006	"Effect of disparity and motion on visual comfort of stereoscopic images" [21]	Filippo Speranza, Wa J. Tam, Ron Renaud, Namho Hur, CRC Canada (Canada)	194
2007	"Visual discomfort in stereoscopic displays: a review" [22]	MTM Lambooij, WA IJsselsteijn, Technische Univ. Eindhoven (Netherlands); I Heynderickx, Philips Research Labs. (Netherlands) and Technische Univ. Delft (Netherlands)	223
2008	"Stereoscopic image quality metrics and compression" [23]	Paul Gorley, Nicolas Holliman, Durham University (United Kingdom)	151
2009	"A novel 2D-to-3D conversion technique based on relative height-depth cue" [24]	YJ Jung, A Baik, J Kim, D Park, Samsung Advanced Institute of Technology (South Korea)	90
2010	"No-reference stereoscopic image quality assessment" [25]	R Akhter, Univ. of Manitoba (Canada); Z M Parvez Sazzad, Yuukou Horita, Univ. of Toyama (Japan); D Meek, Univ. of Manitoba (Canada)	107
2011	"How are crosstalk and ghosting defined in the stereoscopic literature?" [26]	Andrew J. Woods, Curtin University (Australia)	75
2012	"Quality of experience model for 3DTV" [27]	Wei Chen, Jérôme Fournier, Marcus Barkowsky, Patrick Le Callet, France Télécom R&D (France)	52
2013	"Methodology for stereoscopic motion-picture quality assessment" [28]	A Voronov, D Vatolin, D Sumin, V Napadovsky, A Borisov, Moscow State University (Russia)	32
2014	"Automatic detection of artifacts in converted S3D video" [29]	A Bokov, D Vatolin, A Zachesov, A Belous, M Erofeev, Moscow State University (Russia)	15
↳Tie	"Accommodation response measurements for integral 3D image" [30]	Hitoshi Hiura, Tomoyuki Mishina, Jun Arai, Yuichi Iwadate, NHK Science & Technical Research Labs. (Japan)	15
2015	"An objective method for 3D quality prediction using visual annoyance and acceptability level" [31]	D Khaustova, Orange SA (France); O Le Meur, Univ. de Rennes 1 (France); J Fournier, E Wyckens, Orange SA (France)	12
2016	"New visual coding exploration in MPEG: Super-MultiView and Free Navigation in Free viewpoint TV" [32]	G Lafruit, Université Libre de Bruxelles (Belgium); K Wegner and T Grajek, Poznan University of Technology (Poland); T Senoh, National Institute of Information and Communications Technology; J Jung, Orange Labs (France); P Kovács, Holografika (Hungary); P Goorts and L Jorissen, Hasselt University; B Ceulemans, Vrije Universiteit Brussel; P Lopez and S Lobo, Universidad Politécnica de Madrid (Spain); Q Wang, Zhejiang University (China); and M Tanimoto, Nagoya Industrial Science Research Institute (Japan)	24

Table 2: Top 20 cited SD&A papers (as at January 2019)

Rank	Title	Author(s)	Year	Citation Count
1	"Depth-image-based rendering (DIBR), compression, and transmission for a new approach on 3D-TV" [6]	Christoph Fehn, Fraunhofer-Institut fur Nachrichtentechnik (Germany)	2004	1533
2	"Image distortions in stereoscopic video systems" [9]	Andrew J. Woods, Tom Docherty, Rolf Koch, Curtin University (Australia)	1993	589
3	"Variation and extrema of human interpupillary distance" [33]	Neil A. Dodgson, Cambridge University (UK)	2004	389
4	"Perceptual issues in augmented reality" [12]	David Drascic, Paul Milgram, University of Toronto (Canada)	1996	381
5	"Controlling perceived depth in stereoscopic images" [17]	Graham R. Jones, Delman Lee, Nicolas S. Holliman, David Ezra, Sharp Labs. of Europe Ltd. (United Kingdom)	2001	275
6	"Visual discomfort in stereoscopic displays: a review" [22]	MTM Lambooij, WA IJsselsteijn, Technische Univ. Eindhoven (Netherlands); I Heynderickx, Philips Research Labs. (Netherlands) and Technische Univ. Delft (Netherlands)	2007	223
7	"Characterization and optimization of 3D-LCD module design" [13]	Cees Van Berkel, JA Clarke, Philips Research Labs. (United Kingdom)	1997	207
8	"Image preparation for 3D LCD" [15]	Cees van Berkel, Philips Research Labs. (United Kingdom)	1999	197
9	"Effect of disparity and motion on visual comfort of stereoscopic images" [21]	Filippo Speranza, Wa J. Tam, Ron Renaud, Namho Hur, CRC Canada (Canada)	2006	194
10	"Stereoscopic image quality metrics and compression" [23]	Paul Gorley, Nicolas Holliman, Durham University (UK)	2008	151
11	"Hologram-like video images by 45-view stereoscopic display" [34]	Y Kajiki, H Yoshikawa, T Honda, Telecommunications Advancement Organization of Japan (TAO) (Japan)	1997	144
12	"Rapid 2D-to-3D conversion" [18]	PV Harman, J Flack, S Fox, M Dowley, Dynamic Digital Depth (Australia)	2002	139
13	"Depth keying" [19]	R Gvili, A Kaplan, E Ofek, G Yahav, 3DV Systems Ltd. (Israel)	2003	136
14	"DepthCube solid-state 3D volumetric display" [35]	A Sullivan, LightSpace Technologies (USA)	2004	132
15	"Autostereogram" [5]	CW Tyler, MB Clarke, Smith-Kettlewell Eye Research Institute (USA)	1990	131
16	"Geometry of binocular imaging" [10]	VS Grinberg, GW Podnar, M Siegel, Carnegie Mellon Univ. (USA)	1994	129
17	"Mapping perceived depth to regions of interest in stereoscopic images" [36]	NS Holliman, University of Durham (United Kingdom)	2004	116
18	"Multiview 3D LCD" [37]	C van Berkel, DW Parker, AR Franklin, Philips Research Labs. (United Kingdom)	1996	113
19	"Platelet-based coding of depth maps for the transmission of multiview images" [38]	Y Morvan, P de With, D Farin, Eindhoven University of Technology (The Netherlands)	2006	109
20	"No-reference stereoscopic image quality assessment" [25]	R Akhter, ZMP Sazzad, Y Horita, J Baltes, University of Manitoba (Canada) and University of Toyama (Japan)	2010	108

Table 3: *Top 20 SD&A YouTube Videos 2014-2018*

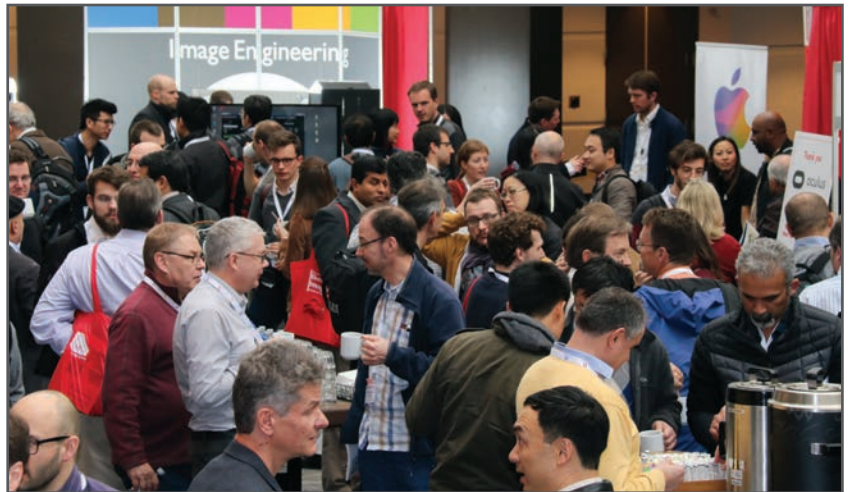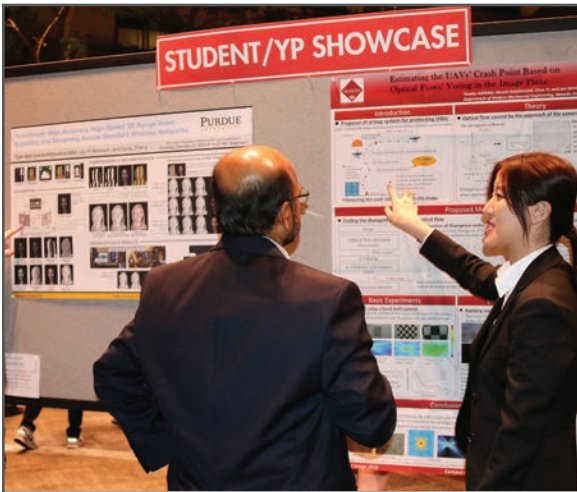| Video Title	views	Average view duration (mins)	Watch time (mins)
SD&A 2016: LEIA 3D: holographic reality	11,991	3.5	42,211
SD&A 2016: 3D will be back but not as we know it	3,611	5.4	19,480
SD&A 2016: 3D autostereoscopic display image generation using direct light field rendering	2,823	2.9	8,059
SD&A 2016: Capturing and rendering light-field video: Approaches and challenges	2,580	4.2	10,933
SD&A 2014: Interpolating vertical parallax for an autostereoscopic 3D projector array [9011-5]	2,019	4.1	8,290
SD&A 2014: Fully automatic 2D to 3D conversion with aid of high-level image features [9011-29]	1,911	1.9	3,551
SD&A 2014 Keynote: Compressive displays: combining optical fabrication, computational... [9011-81]	1,553	11.8	18,274
SD&A 2015: Interactive stereo games to improve vision in children with amblyopia [9391-8]	1,311	3.5	4,567
SD&A 2015 Keynote: What is stereoscopic vision good for? [9391-49]	1,275	7.3	9,320
SD&A 2014 Keynote: Preservation and exhibition of historical 3D movies [9011-83]	1,216	3.4	4,095
SD&A 2015 Keynote: Ian Bickerstaff, Sony Computer Entertainment (UK) [9391-50]	1,051	6.6	6,927
SD&A 2016: 360-degree three-dimensional display with the virtual display surface	1,018	3.7	3,725
SD&A 2014: Time-division multiplexing parallax barrier based on primary colors [9011-46]	915	2.4	2,191
SD&A 2014: Stereoscopic depth perception in video see- through augmented reality... [9011-31]	904	1.9	1,748
SD&A 2015: A novel optical design for light field acquisition using camera array [9391-6]	839	2.8	2,374
SD&A 2016 Keynote: 3-D movie rarities	733	2.9	2,154
SD&A 2016: Application of light field displays to vision correction and accommodation support	588	4.3	2,513
SD&A 2014: A variable-collimation display system [9011-80]	585	3.4	2,005
SD&A 2014: Vision-based calibration of parallax barrier displays [9011-44]	508	2.8	1,422
SD&A 2014: Multi-user autostereoscopic display based on direction-controlled illumination [9011-47]	503	4.7	2,374