On the Death of Scientific Visualization
IEEE VIS 2016 Panel Proposal

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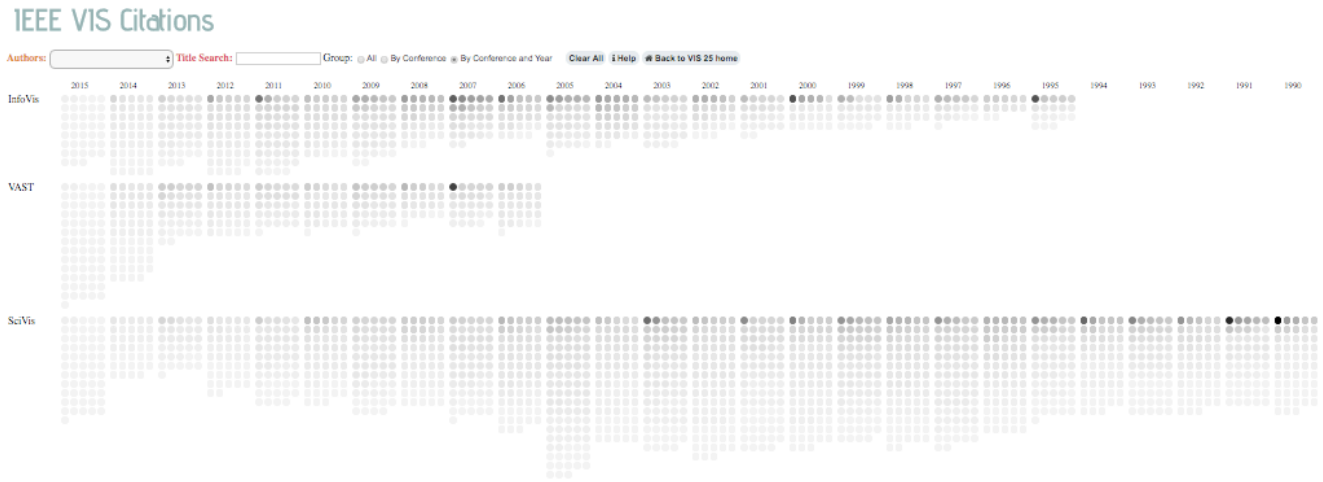

Figure 1 The insightful CiteVis [3] for visualizing citation information over the entire history of the IEEE VIS conference since 1990.

1 Introduction

The beautiful CiteVis shows what appears to be an interesting trend, and that is the contraction of the SciVis track of the IEEE VIS (Visual Analytics, Information Visualization, and Scientific Visualization) conference [3]. See Figure 1. The SciVis track of the conference grew, in general, since its inception in 1990. It enjoyed a period of expansion for approximately 12-15, years until 2002-2005. Since 2006, SciVis has generally been contracting (overall), with the exception of 2015. This apparent contraction coincides roughly withc Bill Lorenson's famous paper on the Death of Visualization [2]. In 2012, the number of IEEE InfoVis papers surpassed that of SciVis for the first time. In 2013 SciVis was also surpassed by IEEE VAST in terms of numbers of papers. While InfoVis and VAST have been expanding since their inception, SciVis seems to be, in general, contracting.

This panel discusses what appears to be a trend of the SciVis track of the conference contracting. This panel addresses some very challenging, core, fundamental questions such as (but not limited to):

- Will the number of SciVis papers continue to decrease in general?
- What could be the cause of this apparent trend?
- Should we, the SciVis Community be concerned about this?
- Do any changes need to be made? Is anything wrong?
- How does this compare to the historic growth of other conferences such as ACM CHI, SIGGRAPH or IEEE CVPR?
- Is this foreshadowing the death of the Scientific Visualization track of the conference?
- What does the long term forecast look like?
- Are there any lessons we can learn from this?

The panel organizer already had some informal discussions on this topic with some well-known leaders in the field. It was clear from these discussions that this is an exciting and interesting topic for further discussion.

2 Why This Panel at IEEE VIS 2016?

This is an important and timely theme for the visualization research community that addresses interesting, difficult and challenging questions. To the best of our knowledge, no such panel has ever been presented. This central topic touches on the experience and interest of every researcher in visualization. It is not only of interest to the SciVis community if the lessons learned can be transferred to the other tracks in the future. It should be especially interesting for both experienced researchers and newcomers to the field. While the choice of future research

directions is very important, there is a wide variety of opinion on this topic within the visualization research community. We think a panel addressing the question of future growth trends in visualization research will form the basis of lively discussions for the panel and more from the audience.

3 Panel Format and Logistics

The panelists will present their positions addressing each question posed in the introduction.

- The introductory remarks will be made by Bob Laramee. His introduction will last for 5 minutes.
- He will chair the panel and he himself is not a panelist.
- Each panelist will be given 5-10 minutes, for a total of 25-45 minutes of presentations.
- This will allow for approximately 35-55 minutes of audience participation in the discussion.
- All panelists will have the opportunity to offer a summary view at the end of the panel (2 minutes each).

The panel chair will solicit audience feedback after the position statements have been delivered. The panel format will also be described in the panel opening.

4 Position Statements

Mike Kirby

Position Statement: Visualization is Facing The Innovator's Dilemma: In his book The Innovator's Dilemma[1], Clayton Christensen argues that all industries must, as a matter of practice, employ sustaining technologies while at the same time being ready to capitalize on disruptive technologies. Sustaining technologies are those that continue to improve and refine the performance and usability of current products and modes of production. Disruptive technologies, however, are those that are transformative – those that force people to act differently and think differently. All areas of human endeavor go through periods of disruption, in which disruptive technologies drastically change or transform our trajectories. These disruptive technologies then solidify into sustaining technologies as we adapt to new path – a path on which we travel until things are disrupted again. SciVis was a sustaining technology, and InfoVis and VAST were disruptive technologies. However, we should not deceive ourselves. The cycle will continue, and soon SciVis, InfoVis and VAST will be on the sustained technology path together. The relevant question is not whether SciVis is dead, but rather how we ride our sustaining technologies while being on the lookout for the next disruptive technology.

David Laidlaw

Position Statement: Do Good Research: Scientific Visualization exists in a bigger context, and rumors of its death are somewhat exaggerated. As one of the constituent components of the annual VIS conference, its role has changed significantly over time. I think that the VIS conference as a whole should be considered in pondering the decline of Scientific Visualization, and, in that broader context, the field is growing, changing, and evolving.

In the beginning, Scientific Visualization stood alone within the IEEE conference and even, to a large degree, outside. It published new algorithms and applications, and it grew. As it grew, more perspectives were represented within the community. Over a number of years, some of these new perspectives spawned symposia within the bigger conference, and some of those symposia matured into so-called conferences within VIS. For the most part, these newer components remained co-located within VIS. The healthy (mostly) negotiations and discussions among the different sub-communities has enriched the VIS conference, helping it remain more vibrant and even providing some constructive competitive pressures.

There are a number of conjectures that could explain why the SciVis-track paper count has declined. One is that the SciVis reviewing process may be viewed as harsher than others, pushing submissions toward the other tracks. Another conjecture is that the SciVis topics have become more mature, reducing the pool of exciting and novel SciVis ideas to draw from. A third conjecture is that authors may feel that VAST, InfoVis, BioVis, or LDAV are more exciting or modern places to have their work showcased. SciVis may have become the miscellaneous choice of venue within VIS. A fourth conjecture is that we have created enough scientific-visualization knowledge that most visualization users are satisfied. And, finally a fifth conjecture is that there is substantial pressure to automate everything, and data analysis is no exception. Machine learning and data science approaches sometimes seek that goal, perhaps obviating the need for some visualization.

But I don't think any of these conjectures matter to our field. My suggestion for keeping our field productive and growing is that we do good research, carefully identifying, articulating, and demonstrating the contributions of our research. This one sentence is the most important of this position statement. As a field, we are not doing as well as we could at these essential steps:

1) identifying the contributions of our research,
2) articulating those contributions clearly, and
3) demonstrating the value of those contributions convincingly.

Certainly, there are notable exceptions to this criticism, but too often accepted work requires detective work to discover its contributions and faith in the value of the contribution rather than evidence of it.

I have no doubt that everyone who submits a paper to VIS intends to be producing good research results that are well explained -- there is no ill intent here. But, as a field, I think that we can improve. Programs like the doctoral colloquium are terrific steps towards helping new researchers be more successful. But I think that all the components of the VIS conference could be improved with a clearer focus on choosing good research problems, designing good research plans, communicating research results clearly, and teaching ourselves and our students how to do so.

Klaus Mueller

Position Statement: Towards Periodic Behavior: I do not think that SciVis is dying. When you look at the chart, there is a clear periodic trend. After a peak in 2005 there was a decline which ended in 2013 and now the trend is pointing upward. SciVis is now at the level it was in 1995 – 20 years ago. So this points to a period of 20 years. Coincidentally, there is something called the 20-year cycle in fashion. Things that were en vogue in the 70s returned in the 90s and then again were re-imagined into the current fashion, with its own modern twist. And this re-

imagination is what SciVis is now experiencing, with the new twists being data science, UX, VR, and AR, along with new gadgets and accessories, such Oculus Rift, Google Glass, Microsoft HoloLens, and of course data, data, and even more data. At the same time, fashion also commonly borrows from other fashions – SciVis makes use of D3.js (infoVis), human computer interfaces (CHI), and machine learning (NIPS) – and re-imagines them for its own style and identity. What SciVis as a fashion needs is innovative designers – aka paper chairs, steering committee members – and daring fashionistas who enthusiastically embrace the new trends, play with them, synergize, and re-inspire the designers. Arguably, the name **Sci**Vis sounds a bit old-fashioned – because it is old – and some may think that **Sci** is less cool than **Info** but now we have Data **Sci**ence and this is the new twist that is making SciVis cool and fashionable again.

Han-Wei Shen

Position Statement: Scientific Visualization Is Not Dead. Instead, it is the most mature area among the three subareas (VAST, InfoVis, SciVis) of the IEEE Visualization conference. When we are judging whether IEEE SciVis receives a good number of submissions compared to the other conferences, we need to keep in mind the size of the intended users. For SciVis, the intended users are scientists, the number of which is clearly much less compared to the professions that the other two conferences are focused on. In addition, there are other factors that contribute to the current trend of SciVis paper submission. For instance: (1) Difficult to Innovate: it is known that IEEE SciVis traditionally is focused more on fundamental algorithms, which is relatively more difficult to innovate. As a result, many authors choose to submit their work to the other conferences even though their underlying applications belong to sciences. (2) Limited access to data: visualization scientists live on the data that they can get. Compared to other types of data, meaningful scientific data sets are very difficult to come by. As a result, the effort required to publish a SciVis paper is much higher (3) Limited computation resources: many scientific data sets are large, which often require high performance computation hardware to process. Because most people do not have access to high performance computers, it is much difficult to compete and come up with strong publications (4) Self-section: it has been more than two decades since the inception of scientific visualization research. Therefore, it is now much harder to get one's work accept to the conference. As a result, many people choose to submit to the other conferences under a not unnecessarily correct impression that they would have a better chance. Although we are facing many challenges as listed above, I strongly believe that SciVis research will continue to stay strong, although successful works need to have a whole new level of innovation, validation, and evaluation. In this panel, I will share examples and also my own experience how to cope with the challenges.

Anders Ynnerman

Position Statement: New Paradigms. Producing scientific publications in a standardized format has been the dominant means of documenting and communicating scientific results and accomplishments ever since the invention of modern printing technology in the 15th century. A tradition of publishing "papers" has evolved based on the notion of a physically printed journal, distributed through traditional means and with physical copies available in libraries. The definition of a "paper" is still today based on the notion of a tangible analog paper based publication. In this statement I challenge two fundamental aspects of the publication tradition in the scientific visualization community, as I believe that they are closely connected to the false rumor of a declining research field.

With the advent of electronic media most of the limitations of traditional publishing do no longer exist. This refers to basic aspects such as number of published papers and number of pages per publication, but it also offers new possibilities such as hyperlinking of material, which may limit the need to provide contextual background information and related works sections in papers, effectively making publications shorter and more concise. The possibility of producing a "Wikipedia of science", which replaces the traditional publication is an enticing thought. It is surprising that after more than 20 years of electronic publication, "papers" are still produced in formats that are essentially digital copies of the analog publications. In a maturing community at the core of digital and visual media it is perhaps time go beyond the paper and regard computer code, interactive visualizations, data etc. as more important parts of our dissemination and also avoid lengthy and repetitive descriptions of introductions and backgrounds to small, but significant contributions. The scientific visualization community is well fitted to spearhead this development.

Another and more immediate item of concern is the fact that publications in the visualization community are, in contrast to many other scientific communities, closely connected to presentations at conferences, and recently even more so as conference papers are often published in journals. At a conference there is a limited number of slots for presentations, which then limits the number of papers that can be accepted. The competitive nature of conference publication thus effectively limits the fraction of papers that can be accepted. A popular means of valuing the quality of a conference is the acceptance rate, which based on traditions has been set to 25% as a bar for leading conferences and journals in our field. I would argue that acceptance rate is a very poor measure of quality, as it is based on an artificial relative metric rather than on assessment of absolute quality of a scientific paper. In a maturing community with a large quantity of papers that are deemed as "good" the selection of papers to be presented at a conference becomes increasingly random. It could be argued that this mechanism is affecting the number of submissions to the scientific visualization conference and leads to the statements such as "It is easier to get accepted in …" despite the fact that the number of submissions is declining. The situation should inspire the community to reconsider the tradition of submitting papers to conferences and indeed the use of acceptance rate as a quality metric.

5 BIOGRAPHIES

Robert M. (Mike) Kirby: Robert M. Kirby received the M.S. degree in applied mathematics, the M.S. degree in computer science, and the Ph.D. degree in applied mathematics from Brown University, Providence, RI, in 1999, 2001, and 2002, respectively. He is currently a Professor of Computing with the School of Computing, University of Utah, Salt Lake City, and a faculty member within the Scientific Computing and Imaging Institute, University of Utah. His current research interests include scientific computing and visualization. He is one of the 2016-2017 SciVis Paper Chairs.

David Laidlaw: David H. Laidlaw is a professor of computer science at Brown University. He received his PhD from Caltech in computer science, where he also did postdoctoral work in the Division of Biology. His research interests revolve around visualization and modeling applications of computer graphics and computer science to other scientific disciplines. He is working with researchers in, for example, archeology, developmental neurobiology, evolutionary biology, medical imaging, neuropathology, orthopedics, art, cognitive science, remote sensing, and fluid mechanics to develop new computational applications and to understand their strengths and weaknesses. Some research problems of particular interest are visualization of multivalued multidimensional imaging data, comparisons of virtual and non-virtual environments for scientific tasks, and applications of art, perception, and cognition to visualization. Dr. Laidlaw has published more than 100 peer-reviewed journal and conference papers, is an IEEE Fellow, has served on or co-chaired dozens of conference committees, has been an associate editor of IEEE Transactions on Visualization and Computer Graphics, was awarded the 2008 IEEE VGTC Visualization Technical Achievement Award, and has been the recipient of a number of other research related awards from IEEE Visualization, ACM SIGGRAPH, and NSF. David served as SciVis Papers Co-Chair in 2012 and 2013.

Klaus Muller: Klaus Mueller received a PhD in computer science from Ohio State University and is currently a professor of computer science at Stony Brook University. His research interests are visualization, visual analytics, and medical imaging. He won the NSF CAREER award in 2001 and the SUNY Chancellor Award for Excellence in Scholarship and Creative Activity in 2011. He is the current chair of the IEEE Technical Committee for Visualization and Graphics and a former Associate Editor of IEEE TVCG.

Han-Wei Shen: Han-Wei Shen is a full professor at The Ohio State University. He received his BS degree from Department of Computer Science and Information Engineering at National Taiwan University in 1988, the MS degree in computer science from the State University of New York at Stony Brook in 1992, and the PhD degree in computer science from the University of Utah in 1998. From 1996 to 1999, he was a research scientist at NASA Ames Research Center in Mountain View California. His primary research interests are scientific visualization and computer graphics. Professor Shen is a winner of National Science Foundation's CAREER award and US Department of Energy's Early Career Principal Investigator Award. He also won the Outstanding Teaching award twice in the Department of Computer Science and Engineering at the Ohio State University.

Hen-Wei Shen serves on the IEEE Visualization Executive Committee and the IEEE Visualization Steering Committee. He was IEEE SciVis Papers Co-Chair, in 2013 and 2014.

Anders Ynnerman: Professor Anders Ynnerman received a Ph.D. in physics from Gothenburg University, Sweden. During the early 90s he was at Oxford University, UK, and Vanderbilt University, USA. From 1997 to 2002 he directed the Swedish National Supercomputer Centre and from 2002 to 2006 he directed the Swedish National Infrastructure for Computing (SNIC). Since 1999 he holds the chair in scientific visualization at Linköping University and is the director of the Norrköping Visualization Center - C.

Ynnerman is a member of the Swedish Royal Academy of Engineering Sciences and a board member of the Swedish Foundation for Strategic Research. In 2007 Ynnerman was awarded the Akzo Nobel Science award and the Golden Mouse award for Swedish IT-person of the year. In 2009 he received the Athena Award for best medical clinical research in Sweden and in 2010 he received the Swedish Knowledge Award for dissemination of scientific knowledge to the public. In 2011 he received the IVA gold medal from the King of Sweden. He is currently chair of the Eurographics Association and an associate editor of IEEE TVCG. Anders served as SciVis Papers Co-Chair in 2013 and 2014.

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