GUEST EDITORS INTRODUCTION: Applied Visualization

This special issue contains a selection of papers that discuss successful applications of visualization methodology to real-world problems. The lineup includes diverse use-cases, from teaching particle physics via medical diagnostic support to helping students identify job opportunities.

A toolmaker succeeds as, and only as, the users of his tool succeed with his aid. However shining the blade, however jeweled the hilt, however perfect the heft, a sword is tested only by cutting. That swordsmith is successful whose clients die of old age.

Frederick P. Brooks Jr.¹

Over more than three decades, the field of (computer-based) visualization has matured into a full-grown research discipline. Fundamental research in visualization, however, has always been a means to an end; from the outset, the field was meant to be inherently interdisciplinary, with working solutions inspired by and requiring the collaboration of visualization experts and prospective users. The seminal report by McCormick et al. suggests: “to get visualization tools into ‘the hands and minds’ of scientists. Scientists would team up with visualization researchers in order to solve […] problems grounded in the needs and methods of an explicit discipline.”² This report spawned a self-understanding that original research in visualization should be—first and foremost—informed by application needs. Challenging application problems make for interesting visualization research questions, and in return, visualization research generates new tools and methods that help push the envelope of the respective application domain.

As the field matured, voices suggested that the link between visualization research and applications weakened.³ Today, the visualization community tackles important research questions motivated by real-world challenges, including the ongoing effort to tame ever increasing amounts of raw data originating from a host of different sources including supercomputer simulations, large-scale experiments, or business transactions in the “always-on” age. And yet, due to the increased specialization of researchers and ever more refined visualization techniques, it has become increasingly difficult to disseminate success stories of visualization in practice inside the confines of the traditional, peer-reviewed publication ecosystem.

A recent panel at IEEE VIS 2016 (Apply or Die) and the subsequent position paper summarize the challenges assessing the quality of application papers.⁴ This position paper explicitly points out the fruitful cross-pollination between domain science and visualization that has been driving the field for many years. The authors encourage the continued work between domain scientists and visualization researchers in several ways. In their conclusion, Weber et al. argue, “that a
healthy dose of application contributions is key to building a lively, relevant, and vibrant visualization research community for decades to come.\textsuperscript{4}

In an effort to bring more practitioners to IEEE VIS, the IEEE Workshop on Visualization in Practice (VIP) provides an opportunity for visualization practitioners and researchers to meet and share experiences, insights, and ideas in applying the latest visualization and visual analytics research to real world problems. Held in different forms since IEEE VIS 2015 in Chicago, the workshop targets work at the interface between visualization research and specific application domains. Last year’s iteration specifically focused on “Visualization Solutions in the Wild,” including tools, systems, and frameworks that are in active use.

**IN THIS ISSUE**

We conceived this special issue as a forum for ongoing application-driven visualization research, integrating ideas that fueled both the 2016 panel and the VIP workshop. In fact, the first paper “Belle2VR: A Virtual Reality Visualization of Subatomic Particle Physics in the Belle II Experiment” is an invited, significantly extended contribution from VIP 17: the proposed system helps visualize complex collision processes of particles in high-energy physics. The authors specifically designed it with a teaching context in mind. The system uses virtual reality technology to create an immersive, freely explorable replica of the actual collider including recorded event data.

The authors of “OpenSpace: Changing the Narrative of Public Dissemination in Astronomical Visualization from What to How” discuss how the OpenSpace system helps disseminate scientific discoveries, in this case the exploration and explanation of phenomena in space. One of the system’s applications was the real-time visualization of incoming data from NASA’s New Horizons mission. When the spacecraft passed Pluto in 2015, incoming image data was mapped to a virtual representation of Pluto in the very moment it became available. In this manner, New Horizons’ flyby could be followed live by some 2,000 viewers all over the world.

Next, the authors of “Management of Morphological Descriptors based on an Automatic Ostium Extraction for Cerebral Aneurysms” support medical experts in assessing the rupture risk of aneurisms. They address the challenge of supporting users with automatic segmentations on the one hand, while enabling the seamless integration of expert knowledge on the other.

Staying in the realm of medical applications, the paper “Toward a Multimodal Diagnostic Exploratory Visualization of Focal Cortical Dysplasia” faces the challenge of consistently fusing multiple volume data sets in order to enhance the surgical treatment of focal cortical dysplasia.

Finally, “Application Driven-Design: Helping Students Understand Employment and See the Big Picture” focuses on developing a system for helping students understand future job prospects. Designed in conjunction with career counseling services in the university, this paper discusses design requirements and a classroom study where real end users engaged with JobViz.

**INTO THE FUTURE**

From the outset, we aimed at creating a forum for application-oriented work that successfully addresses a specific, well-defined need, and demonstrates its relevance to the target user group. Moreover, we were looking to include fresh applications outside the well-trodden paths of flow vis or graph visualization. While space constraints do not allow us to give a representative, complete overview over all uses of visualization technology, we hope that the selection in this special issue is varied enough to inspire more discussions about the practical relevance of our diverse field at large.
REFERENCES


ABOUT THE AUTHORS

**Bernd Hentschel** is a senior researcher at RWTH Aachen University. He received his PhD in computer science from RWTH Aachen. Hentschel’s research interests include parallel visualization algorithms, virtual reality in general and immersive visualization in particular. Contact him at hentschel@vr.rwth-aachen.de.

**Miriah Meyer** is an Associate Professor at the University of Utah. She received a PhD in Computer Science from the University of Utah. Meyer’s research interests include visualization design studies and design methodologies. Contact her at miriah@cs.utah.edu.

**Hans Hagen** is a Full Professor and director of a research center at the University of Kaiserslautern. He received his PhD in mathematics (differential geometry) from the University of Dortmund. His research interests include visualization, geometric modelling, and scientific computing. Contact him at hagen@informatik.uni-kl.de.

**Ross Maciejewski** is an Associate Professor at the Arizona State University. He received a PhD in Computer Engineering from Purdue University. Maciejewski’s research interests include visual analytics, geography, and data science. Contact him at rmacieje@asu.edu.