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Published in:
IEEE Transactions on Visualization and Computer Graphics

DOI:
10.1109/TVCG.2011.149

Published: 01/01/2011

Document Version
Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

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Download date: 22. Nov. 2018
Guest Editor’s Introduction: Special Section on the IEEE Pacific Visualization Symposium

Stephen North, Member, IEEE Computer Society, Han-Wei Shen, Member, IEEE Computer Society, and Jarke J. van Wijk, Member, IEEE Computer Society

This special section of IEEE Transactions on Visualization and Computer Graphics (TVCG) presents extended versions of several of the outstanding papers from the IEEE Pacific Visualization Symposium 2010. The symposium was held in Taipei, Taiwan, from 2-5 March 2010. The papers published here convey the breadth and high quality of the technical program. It is exciting to see that this annual symposium has become an established forum in its third year.

In “Visualization of High-Dimensional Point Clouds Using Their Density Distribution’s Topology,” Patrick Oesterling, Christian Heine, Heike Jänicke, Gerik Scheuermann, and Gerhard Heyer propose a novel and powerful solution to the classic problem of multivariate data visualization. Scatterplots are usually understandable when data sets have a low number of dimensions, but they fall short when the number of dimensions increases. An alternative proposed by Oesterling et al. is to consider the input data points as samples of a density distribution. They extract the topological structure of this distribution and present the resulting structure as a two-dimensional landscape, revealing both individual data points, and dense clusters that show up as hills. As shown by examples, the resulting visualizations can provide improved insight in the structure of high-dimensional data sets, and thanks to a series of optimizations, the visualizations can be generated efficiently and adjusted interactively.

Transfer function design is one of the most challenging problems in volume rendering. This is because features of interest in different spatial locations are difficult to separate, since they may have overlapping value ranges with similar gradients. In “Efficient Volume Exploration Using the Gaussian Mixture Model,” by Yunhai Wang, Wei Chen, Jian Zhang, Tingxing Dong, Guihua Shan, and Xuebin Chi, the authors use the Gaussian Mixture Model (GMM) and the maximum likelihood principle to extract coherent regions from a 2D feature space defined on data values and gradients. Each of the mixture components is then associated with an Elliptical Transfer Function (ETF) that can be directly manipulated by the user. A noteworthy contribution of the paper is that the authors derive an analytic form from the ETF to facilitate preintegrated volume rendering. The authors also extend the GMM model to time-varying data using an incremental method. The resulting transfer function can maintain temporal coherence when rendering features in a time-varying field.

Understanding fluid flows is important in many scientific disciplines. In the past two decades, many techniques have been proposed for visualizing three-dimensional time-varying flows, but hardly any can simulate what fluid flow scientists would see in a real-world laboratory. In “Physically-Based Interactive Flow Visualization Based on Schlieren and Interferometry Experimental Techniques,” by Carson Brownlee, Vincent Pegoraro, Siddharth Shankar, Patrick S. McCormick, and Charles D. Hansen, the authors present efficient techniques to generate images from simulation data very similar to traditional flow visualization such as shadowgraphs, interferometry, and Schlieren photography. They present a method to model light refraction when tracing light paths through time-varying flow fields. The authors show that it is possible to compute Schlieren-like photographs at interactive frame rates using a combination of preprocessing and acceleration techniques. An important benefit of their proposed technique is that it makes it easier to validate simulation data, since the images are comparable to visualizations generated by traditional lab experiments. This work received the Best Paper prize at the 2010 Pacific Visualization meeting.

Visualization of large graphs is an important problem in information visualization. Vladimir Batagelj, Franz J. Brandenburg, Walter Didimo, Giuseppe Liotta, Pietro Palladino, and Maurizio Patrignani describe “Visual Analysis of Large Graphs Using (\(X, Y\))-Clustering and Hybrid Visualizations.” The paper proposes topologically-based clustering methods, including finding planar subgraphs, \(k\)-cliques, and \(k\)-cores. It provides a basis for determining when various types of \((X, Y)\) clusterings can be computed efficiently. Though the general problem of choosing and computing optimal \(X\) and \(Y\) clusterings remains quite challenging, the authors propose a hybrid top-down, two-level heuristic for interactive visual analysis of large networks. They demonstrate this on data sets having thousands of nodes and edges, extracted from a scientific coauthorship network. The proposal is a promising step toward improved visualization of large graphs by means of theoretically-well-founded techniques.

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As editors of this special section, we thank the Editors-in-Chief and staff of TVCG for the opportunity to present this work. We especially thank the nine anonymous reviewers, whose acute insight and advice did much to enhance the quality of the final papers. We look forward to future meetings of Pacific Visualization and encourage our colleagues to consider submitting their work to future meetings.

Stephen North
Han-Wei Shen
Jarke J. van Wijk

Guest Editors

Stephen North received the PhD degree in computer science from Princeton University. He is director of Information Visualization Research at AT&T Labs Research in Florham Park, New Jersey, and has been an AT&T fellow since 2008. He has served as the technical program chair or cochair of IEEE InfoVis, IEEE Pacific Visualization, IEEE VizSEC, and the International Graph Drawing Symposium. He is interested in applied algorithms for information visualization, scalable visualization systems, and applications. He is one of the authors of Graphviz, an open source network visualization system that won two Apple Design Awards. He was an early contributor to the field of personal computing. He is a member of the IEEE Computer Society.

Han-Wei Shen received the BS degree from the 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. He is an associate professor at The Ohio State University. 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 the US National Science Foundation's (NSF) CAREER award and the US Department of Energy's (DOE) 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. He is a member of the IEEE Computer Society.

Jarke J. van Wijk received the PhD degree in computer science from the Delft University of Technology. He is a full professor of visualization at the Eindhoven University of Technology. His main research interests are information visualization, visual analytics, and mathematical visualization. He received the 2007 IEEE Visualization Technical Achievement award and has been technical program cochair for IEEE Visualization, IEEE InfoVis, IEEE VAST, IEEE PacificVis, and EG/IEEE EuroVis. He is a member of the IEEE Computer Society.