Guest Editor's Introduction to the Special Section on the 2016 IEEE Pacific Visualization Symposium

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THIS special section of *IEEE Transactions on Visualization and Computer Graphics (TVCG)* presents six extremely highly rated papers from the 2016 IEEE Pacific Visualization Symposium (IEEE PacificVis'16) which was held at the National Taiwan University of Science and Technology, Taipei, Taiwan during April 19 to 22, 2016. The IEEE Pacific Visualization Symposium is the premier symposium, in the Asia-Pacific Rim region, sponsored by the Technical Committee on Visualization and Computer Graphics (VGTC). IEEE PacificVis brings together researchers in information visualization, scientific visualization and visual analytics to facilitate the exchange of research ideas and results.

Visualization and visual analytics come together to solve important problems through the use of visual representations and systems for problem solving across various domains. The review process for the conference was a double blind, two-stage review where multiple program committee members and external reviewers provided at least four reviews for each paper. The submissions this year were outstanding and the conference accepted 30 percent of the submitted papers. This year, in cooperation with *IEEE TVCG*, the IEEE Pacific Visualization 2016 papers co-chairs analyzed the first round of reviews and determined that the six papers included in this special section were outstanding. This represents the top 6 percent of all submissions. These six papers were accepted directly to *IEEE TVCG* when the authors revised the original manuscripts as required by the minor revision criteria. The result is this special section of *IEEE TVCG* on IEEE Pacific Visualization 2016. In the rest of this introduction we provide a brief overview of these six papers.

Stacked graphs are among of the oldest and the most widely used visual representations of multiple time series data because they are capable of hierarchically visualizing a set of temporal sequences as well as their aggregation. They have been used in various applications such as email messages, sentiments and music listening histories. "PieceStack: Toward Better Understanding of Stacked Graphs" systematically analyzes how stacked graphs are generated with the individual layers by exploring similarities/differences between layers, as well as between layers and the overall trend, especially among local intervals. Based on this analysis, the authors propose a an interactive system using partial sequence clustering on stacked graphs, which interprets every time period in detail without being constrained by the overall complex changes. Case studies and a user study demonstrate the effectiveness of PieceStack for understanding individual and aggregated patterns of temporal sequences.

Graph drawing methods typically reduce the number of edge crossings. In the paper "Minimizing the Number of Edges via Edge Concentration in Dense Layered Graphs", the authors describe a technique to reduce the number of edges in a graph through edge concentration with the goal of making more readable graphs from dense data. Specifically, they employ a greedy approach to repeatedly finding a biclique to the number of edges. The novel method reduces the number of edges by 50 to 80 percent and is demonstrated by applying the method to biological data where a causality network of feature values obtained through experimental observations effectively simplifies the network to help domain specialists understand causal relationships of the feature values.

Distance based layout methods have difficulties for graphs with low pair wise shortest-path distances. Parametric methods have been used to attempt to resolve this problem. However, the parameters have typically been selected manually and individually for each input instance. The paper "Adaptive Disentanglement based on Local Clustering in Small-World Network Visualization" describes a method based on using graph invariants to automatically determine reasonable parameters. The method is applied to social network data and confirms the effectiveness of the technique.

Typically, Finite-Time Lyapunov Exponents (FTLE) and Lagrangian Coherent Structures (LCS) are deterministically defined. By introducing a stochastic definition, temporal uncertainty can be ascertained. The paper "Finite-Time Lyapunov Exponents and Lagrangian Coherent Structures in Uncertain Unsteady Flows" uses probability density functions for every spatial-temporal location and visualizes them with different statistical measurements. Another new formulation of FTLE measures the divergence of particle distributions. By using the PDFs, uncertainty for LCS can be computed using stochastic ridge finding with density estimation algorithms. This new formulation is compared to variance-based methods and applied to ensembles of atmospheric simulations data.

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In "Critical Point Cancellation in 3D Vector Fields: Robustness and Discussion", a new 3D critical point cancellation framework is developed. Vector field topology has typically focused on 2D vector fields. To extend to the 3D regime, it is necessary for algorithms to provide methods for direct cancellation of critical points in 3D. The first framework for the hierarchical cancellation of pairs or groups of 3D critical points, without special boundary conditions, is introduced. This framework can remove critical points in a local region as long as the region has zero degree. Several real-world examples are provided which demonstrate the effectiveness of the proposed framework.

The paper "Visual Analysis of Cloud Computing Performance Using Behavioral Lines" presents a visual analysis approach to understanding and analyzing the performance and behavior of cloud computing systems. Since it is impossible to monitor every application and instance in a cloud system, regularly sampled information can provide insight into the system behavior. Such information is critical for understand performance and usage for efficient operations, security and maintenance. The system uses similarity measures and a layout method to portray the behavior of each compute node over time. Distinct pattern appear when analyzing large behavioral lines and these patterns lead to the understanding of performance bottlenecks. In this paper, two case studies, one spanning weeks and the other spanning hours, are used to demonstrate the usefulness of the method.

The guest editors, who were papers co-chairs for the symposium, wish to thank Leila de Floriani, Editor-in-Chief of *IEEE TVCG* for her strong support for this new process of taking the best of the symposia papers, where the reviews indicated a minor revision, as direct submissions to *IEEE TVCG*. We also wish to thank the *IEEE TVCG* editorial staff for their dedicated efforts and assistant in preparing this special session and integrating these papers into their production pipeline. Our thanks are also extended to the international program committee and the anonymous external reviewers for their thoughtful and valuable feedback that resulted in the high quality program for the symposium and the papers appearing in this special section.

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Charles Hansen received a PhD in computer science from the University of Utah in 1987. He is a professor of computer science at the University of Utah and member of the SCI Institute. From 1989 to 1997, he was a Technical Staff Member in the Advanced Computing Laboratory(ACL) located at Los Alamos National Laboratory, where he formed and directed the visualization efforts in the ACL. He was a Bourse de Chateaubriand PostDoc Fellow at INRIA, Rocquencourt France, in 1987 and 1988. His research interests include large-scale scientific visualization and computer graphics.

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