Guest Editors' Introduction: Special Section on IEEE PacificVis 2022

Nan Cao, Timo Ropinski, and Jian Zhao

THIS special section of the IEEE Transactions on Visualization and Computer Graphics (IEEE TVCG) presents the five most highly rated papers from the 2022 IEEE Pacific Visualization Symposium (IEEE PacificVis). This year, IEEE PacificVis was scheduled to be hosted by the University of Tsukuba and held in Tsukuba, Japan, from April 11 to 14, 2022. IEEE PacificVis, sponsored by the IEEE Visualization and Graphics Technical Committee (VGTC), aims to foster greater exchange between visualization researchers and practitioners, especially in the Asia-Pacific region. This forum has grown to be a truly international event, attracting submissions and attendees from many countries in the Asia-Pacific, Europe, America, and beyond. Thus, IEEE PacificVis is serving the additional purposes of sharing the latest advances in visualization with researchers and practitioners in the region and introducing research developments in the region to the broader international visualization research community.

The papers co-chairs employed a two-stage peer-review process to ensure the quality of accepted papers. Each paper was assigned to a primary reviewer and a secondary reviewer from our team of 54 International Program Committee (IPC) members. The primary and secondary reviewers each recruited an additional external reviewer, ensuring a total of at least four reviewers per paper. The review process was single-blind for IPC members and double-blind for external reviewers. This year's submissions were outstanding, and the symposium accepted 21 full papers out of 75 completed submissions. The full paper co-chairs acted as IEEE TVCG guest editors, and selected based on the first round reviews in cooperation with IEEE TVCG, five outstanding papers to appear in IEEE TVCG. These five papers, representing the most highly rated of the IEEE PacificVis 2022 full paper program, were accepted directly by IEEE TVCG after the authors revised the original manuscripts as required by the minor revision criteria. We give a brief overview of these five papers as follows.

When dealing with large-scale meshes, a reduction of the in-memory and on-disk footprints are essential. The authors of "AMM: Adaptive Multilinear Meshes" introduce a novel resolution-precision-adaptive representation to support hybrid data reduction schemes. The presented technique allows for a combination of precision and resolution reduction, which has been shown in the past to be beneficial. To give this hybrid data reduction scheme practical relevance, the authors also offer an interface to existing tools and algorithms. Thus, AMM is the first practical solution for creating and evaluating hybrid reduction representations at scale. The interface to VTK as well as the open source release will likely further contribute to the acceptance of AMM.

Large and arbitrarily structured volumetric data sets also play an important role in many disciplines, such as imaging or simulation. To visualize these data sets, compact representations that allow for interpolation, transfer function application, and other basic operations, are essential. The authors of the paper "Image-based Visualization of Large Volumetric Data Using Moments" propose a novel image-based representation for the visualization of large and arbitrarily structure volumetric data sets. The core idea of the presented representation is to transform the view ray densities for a fixed view to the Fourier basis and storing Fourier coefficients. Compactness is achieved through a combination of adaption with clever coding and quantization strategies. The presented representation not only allows for transfer function changes, but also enables the incorporation of single scattering illumination during visualization.

When working with simulations, domain scientists have to have a clear understanding of the influence of the input parameters on the simulation output. Often, in order to understand this influence, parameter analysis is performed, such that multiple simulation runs are started with different input parameters. To circumvent this compute intensive process, the authors of the paper "GNN-Surrogate: A Hierarchical and Adaptive Graph Neural Network for Parameter Space Exploration of Unstructured-Mesh Ocean Simulations" present GNN-Surrogate as a surrogate model, which predicts simulation outputs accurately and efficiently. GNN-Surrogate employs a graph neural network, and it has been trained on unstructured data to explore the parameter space of ocean climate simulations. To demonstrate the usefulness of GNN-Surrogate, the authors provide quantitative and qualitative evaluations on the MPAS-Ocean simulation.

With the advent of deep convolutional neural networks (CNNs), deep learning has not only triggered significant

- *N. Cao is with the College of Design and Innovation, Tongji University, Shanghai 200092, China. E-mail: nan.cao@tongji.edu.cn.*
- *T. Ropinski is with the Institute of Media Informatics, Ulm University, 89081 Ulm, Germany. E-mail: timo.ropinski@uni-ulm.de.*
- *J. Zhao is with the Cheriton School of Computer Science, University of Waterloo, Waterloo, Canada. E-mail: jianzhao@uwaterloo.ca.*

Digital Object Identifier no. 10.1109/TVCG.2022.3165393

breakthroughs in many fields, it also created new demands for understanding such deep models. The authors of the paper "CNNC: A Visual Analytics System for Comparative Study of Deep Convolutional Neural Networks" address this challenge by proposing CNN Comparator as a visual analytics systems, that allows for the inspection of single CNN models as well as the comparison of multiple CNN models. Explainability support and carefully designed model visualizations are at the core of CNN Comparator, which for the first time supports the comparison of more than two models. The usefulness of CNN Comperator is demonstrated through two use cases and one preliminary evaluation study using the image classification tasks on the ImageNet dataset.

Time-dependent phenomena, often represented as a function over time, are of interest in many real-world visual analytics scenarios. The authors of the paper "A Visual Analytics Approach for Hardware System Monitoring with Streaming Functional Data Analysis" present a visual analytics system which has been designed to allow for analysis of such data in the context of hardware systems. The core of the presented visual analytics system is an incremental and progressive algorithm to generate magnitude-shape plots which convey the functional magnitude and shape outlyingness of time series data. The plots are further integrated into a multi-view system, that allows for functional data analysis. The practical value of the presented system is nicely demonstrated on the basis of two use cases, one on supercomputer hardware logs and another on biometric daily activity data. In both cases valuable expert insights underline the effectiveness of the presented system.

The guest editors would like to thank Klaus Mueller, the Editor-in-Chief of IEEE TVCG, and Han-Wei Shen, the Associate Editor-in-Chief, for their strong support in the process of taking the best of the IEEE PacificVis 2022 papers as minor revisions to IEEE TVCG. We also thank the IEEE TVCG editorial staff for their dedicated efforts and assistance in preparing this special section. Our thanks also go to the IPC and the anonymous reviewers. We thank them for their thoughtful and valuable feedback that resulted in both the high-quality program for the symposium and the papers appearing in this special section. We sincerely hope that you enjoy this sample of the best papers presented at IEEE PacificVis 2022 and consider submitting your work to the IEEE Pacific Visualization Symposium in the future.

Nan Cao
Timo Ropinski
Jian Zhao
Guest Editors

Nan Cao is a professor at Tongji University and the Assistant Dean of the Tongji College of Design and Innovation. He received his Ph.D. degree in Computer Science and Engineering from the Hong Kong University of Science and Technology (HKUST), Hong Kong, China, in 2012. Dr. Cao directs the Intelligent Big Data Visualization Lab and conducts interdisciplinary research across multiple fields, including data visualization, human-computer interaction, machine learning, and data mining. He was a research staff member at the IBM T.J. Watson Research Center, New York, NY, USA, before joining the Tongji faculty in 2016.

Timo Ropinski is a professor at Ulm University, where he is heading the Visual Computing Group. Before moving to Ulm he was Professor in Interactive Visualization at Linköping University in Sweden, where he was heading the Scientific Visualization Group. He has received his Ph.D. in computer science in 2004 from the University of Münster, where he has also completed his Habilitation in 2009. Currently Timo serves as chair of the EG VCBM Steering Committee, and as a editorial board member of IEEE TVCG.

Jian Zhao is an assistant professor in the Cheriton School of Computer Science, University of Waterloo, where he directs the WatVis (Waterloo Visualization) group. He received his Ph.D. from the Department of Computer Science, University of Toronto in 2015. His research interests include information visualization, human-computer interaction, and data science. His work contributes to the development of advanced interactive visualizations that promote the interplay of human, machine, and data.