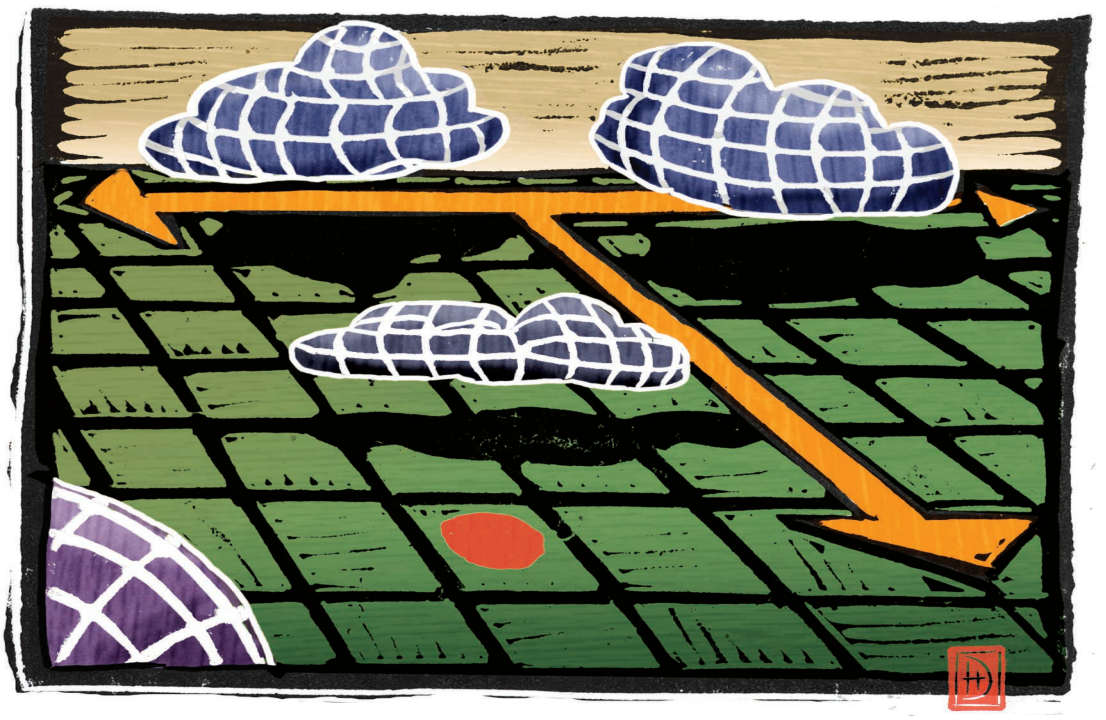
High-Dimensional Data Acquisition, Computing, and Visualization



Today, more complex data is generated and collected than ever before in human history. This avalanche creates opportunities and information as well as difficulties and challenges. Many people and places are dedicated to data acquisition, computing, and visualization, and there is a great need for sharing information and approaches. We called for a special issue of papers in *CiSE* to investigate and study creative methods and systems in receiving, processing, and understanding high-dimensional data. The response was so overwhelming that we had to divide the theme into two separate issues—part II will appear later this year.

The issue you hold in your hands aims to address the challenges in handling and understanding high-dimensional data in different research and application areas, featuring visual clustering, materials visualization, time-varying volume rendering, and an access and analysis

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server. Our intention was to bring together different research and applications in processing and visualizing high-dimensional data so as to foster more insight among this fast-growing community. The topics span innovative approaches and systems for general multidimensional data reduction, clustering, and visualization to specific applications in materials science, Earth science, and medical imaging. We believe that you will find the articles in this issue informative, valuable, and rewarding.

"Using Projections to Visually Cluster High-Dimensional Data" by Alexander Hinneburg, Daniel Keim, and Markus Wawryniuk proposes a new approach to clustering in high-dimensional data sets. They implement this approach in a system called High-Dimensional Eye (HD-Eye). Their method combines the strengths of an advanced automatic clustering algorithm with new visualization techniques. Their experimental evaluation shows that the combination of automatic and visual techniques significantly improves the effectiveness of the data mining process and achieves a better understanding of the results.

"Large Multidimensional Data Visualization for Materials Science" by Ashish Sharma, Rajiv K. Kalia, Aiichiro Nakano, and Priya Vashishta presents creative methods for understanding material processes such as fracture and hypervelocity impact. How does a crack propagate in a composite material? How does a high-speed projectile interact with its target? How can we use this knowledge to make materials with high fracture toughness and impact damage resistance? This article describes a system that can visualize very large data sets and provide materials scientist with the key to such questions.

"Visualizing Time-Varying Volume Data" by Kwan-Liu Ma describes novel approaches for encoding and rendering time-varying, multivariate volume data. Current scientific computing technologies enable accurate numerical modeling of many physical and chemical processes in both their spatial and temporal domains. An increasingly challenging problem is how to effectively explore and understand the resulting time-varying volume data that is large in space, time, and variable domain. How to reduce the storage requirement of a data set without removing fine features is thus the focus of time-varying data visualization research. The article also identifies and discusses emerging trends in time-varying data visualization research and their potential effects on the scientific research community.

"A Distributed Enhanced Server for Multidimensional Scientific Data" by Ruixin Yang, Menas Kafatos, Brian Doty, James L. Kinter III, and Long Pham discusses a three-phase data access model and related data systems that support scientific data search and access. With explosively increasing volumes of remote sensing, modeling, and other Earth science data available, scientists now face the challenge of finding and accessing interesting multidimensional scientific data sets via the Internet. The article presents an Internet server called the enhanced server (ES) for Earth data that greatly benefits researchers in Earth science.

The diverse insights developed in these articles are really impressive. The authors have done a great job in writing about their innovations with illustrative and colorful images. We've tried to summarize the contents here, but you'll get much more from the articles themselves. Happy reading!

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