DATA VISUALIZATION:
THE STATE OF THE ART
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Preface

In this book we survey the state of the art in the field of Data Visualization. The origins of this field are in the early days of computer graphics in the 1950s, when the first graphs and figures were generated by computers. A strong impulse was given to the field by the appearance, in 1987, of the NSF report ‘Visualization in Scientific Computing’, in which the need for new computer-based visualization techniques was stressed. With the rapid increase of computing power, larger and more complex numerical models were developed, resulting in the generation of huge numerical data sets. Also, large data sets were generated by data acquisition devices such as medical scanners and microscopes, and data was collected in large databases containing text, numerical information and multimedia information. Advanced computer graphics techniques were needed to process and visualize these massive data sets.

The NSF report marked the start of a large number of research activities and the emergence of Data Visualization as a new specialism within the field of computer graphics. In 1990, the Eurographics Association started with annual European visualization conferences, and the IEEE Computer Society started the annual IEEE Visualization Conferences. The journal IEEE Transactions on Visualization and Computer Graphics (TVCG) was started in 1995, and several other computer graphics journals and conferences are publishing papers in visualization.

The phrase ‘Visualization in Scientific Computing’ (or ‘Scientific Visualization’) was used initially to refer to visualization as a part of a process of scientific computing: the use of computer modelling and simulation in scientific and engineering practice. More recently, visualization is increasingly also concerned with data from other sources, including large and heterogeneous data collections found in business and finance, administration, digital media, etc. A new research area called ‘Information Visualization’ was launched in the early 1990s, to support analysis of abstract and heterogeneous data sets in many application areas. Therefore, the phrase ‘Data Visualization’ is gaining acceptance to include both the scientific and information visualization fields. Today, data visualization has become a very active and vital area of research and teaching, and this book is a representative survey of this field to illustrate this.

This book was originally planned at the Dagstuhl Seminar on Scientific Visualization, held from 21-26 May, 2000. The IBFI Schloß Dagstuhl was founded in 1990, and is located in the south-west of Germany near Saarbrücken. It offers the opportunity of one-week meetings which bring together a number of prominent researchers from around the world on significant topics in informa-
tion technology. This seminar on visualization was the fourth in a series since 1991, and was attended by 56 scientists from 14 countries. Most of the papers are based on the oral presentations given at the seminar, but they were expanded and updated later. The papers represent a good survey of the state of the art in the field of data visualization.

It would be impossible to cover every aspect of the field in a collection of papers, but we have selected 30 reviewed contributions from well-known visualization researchers, based on recent research of their groups, covering a wide range of topics. It is always a challenging task to categorize these papers into coherent groups, as this amounts to a partitioning of the field into a number of sub-fields, which are usually quite transient in a highly dynamic area. Nevertheless, we have made an attempt, and it has resulted in the following chapters:

1. Visualization Algorithms and Techniques
2. Volume Visualization
3. Information Visualization
4. Multiresolution Methods
5. Modelling Techniques
6. Interaction and Architectures

The intent of this book is to present an overview for the inquiring scientist, and as a basic foundation for developers. Another goal for this book is to provide basic material for teaching state of the art techniques in data visualization. The references included with the papers point out where to obtain further information to complete the course material.

One natural aspect of visualization is the extensive use of colour images and movies. Unfortunately, it was impossible to provide colour images in the printed version of this book. But we have added a CD-ROM to this book which contains all papers (in pdf format), with high quality color images, and a number of movies illustrating the work in the papers.

We would like to express our sincere appreciation to the authors for their interesting contributions, and the editorial staff in Electrical Engineering and Computer Science of Kluwer Academic Publishers in Norwell, Mass. (USA) for their interest and support in publishing this book. Numerous others have helped us to produce this book, especially Paul de Bruin who did the hard work of preparing the final copy for the book, and Charl Botha who designed the layout for the CD-ROM. We would like to thank them all. Finally, we thank the management and staff of Schloß Dagstuhl for smoothly organizing this memorable week, and of course Hans Hagen for his indispensable advice and encouragement. We hope that this book will serve the visualization community and will add to the excellent reputation of the Dagstuhl seminars.

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