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Editorial

Foreword to the special section on visual analytics

The increasing amount of heterogeneous data from different data sources is a challenging problem in many areas. Visual Analytics, a discipline which emerged in the last decade, tries to cope with this issue. Visual Analytics is "the science of analytical reasoning facilitated by visual interfaces" [1]. In other words, Visual Analytics is a combination of automatic, visual, and interactive methods to explore large datasets. To achieve this, Visual Analytics draws on several different disciplines, as e.g., information visualization, data mining, data management, spatio-temporal data analysis, and cognitive psychology [2]. In this context, the human element plays an important role. The seamless interplay between human and computer is essential for getting relevant insights from the data. In this way, Visual Analytics supports the exploration and understanding of large and complex datasets.

In Europe, Visual Analytics was put forward by the VisMaster project [2] that was financed by the European Commission from August 2008 until September 2010. Members of the VisMaster consortium established the EuroVA workshop. The goal of the EuroVA workshop is to provide a forum for researchers in the area of Visual Analytics to present novel research and to discuss new findings. The first of these workshops took place in 2010 in Bordeaux. This special section of Computers & Graphics is based on contributions from the 4th EuroVA workshop in 2013. During the workshop, Silvia Miksch and William Ribarsky presented in their keynotes general overviews of currently discussed topics in Visual Analytics. Short versions of these two keynote talks can be found in this special section together with five regular articles providing Visual Analytics solutions. These papers were selected from the EuroVA workshop, but we also solicited for additional contributions from the community. Some of the papers which were submitted to the call for this special section may be published in upcoming issues of this journal.

In the following, we give a short overview of the contributions contained in this special section.

A fundamental concern of Visual Analytics is the exploration and understanding of large and complex datasets. William Ribarsky addressed this issue in his keynote. In his article [3], he and his co-authors Derek Xiaoyu Wang and Wenwen Dou discuss this issue by applying Visual Analytics for the exploration of social media. They argue that today's business processes are characterized by the necessity to tackle big data. Therefore, it will be a competitive advantage to employ the most advanced systems for these kinds of analysis processes, and particularly to include Visual Analytics methods. In this way, the users are taken into the loop. The authors demonstrate this procedure by the analysis of the reaction of customers to a company's strategy based on data from social media. They show that Visual Analytics helps to understand trends and patterns in the data easily.

In her keynote, Silvia Miksch argued that not only the increasing amounts of heterogeneous data should be addressed, but also the users and their tasks. Hence, in her article [4], she and her co-author Wolfgang Aigner emphasize the importance of integrating the three aspects – data, task, and users – as major factors in the design of Visual Analytics systems. They argue that this design triangle assists developers in their design decisions. Specifically, they emphasize that the adequate handling of the temporal context is an essential aspect of Visual Analytics solutions, because in many large data collections time plays an important role (e.g., in financial or medical data). They discuss several examples that show how the design triangle can be applied for time-oriented data analysis.

In the article by Tim Lammarsch et al. [5], the specifics of time-oriented data are addressed as well. It presents a new approach of finding temporal patterns. The authors argue that existing approaches can handle the temporal order of events, but not temporal relations, such as "meets", "starts", or "during". They introduce a novel procedure to handle such relations. By doing so, they are able to also find unusual patterns that are sometimes hidden among more commonplace patterns in the data. The authors use road traffic as an example and show that, apart from the weekends with their well-known patterns, there are other patterns which can be made transparent by an appropriate analysis and visualization.

The article by Tuan Pham et al. [6] focuses also on the problem of highlighting specific, but often hidden characteristics in the data. It investigates the question of how to make overlapping subgroups in work teams visible. The authors use the concept of faultlines to set the boundaries between different subgroups. This concept is based on a mixture of automatic and visual methods as it is typical for Visual Analytics. A multivariate cluster analysis computes subgroups in work teams, but the numerical results from such an analysis do in most cases not provide a clear idea of how such subgroups are organized and interrelated. Therefore, a simple, but well-designed visual interface supports the users to recognize subgroups in their multi-dimensional context at a glance. To demonstrate the usefulness of the approach, a comprehensive usability evaluation is provided, as well as an example that describes the applicability in a biological context.

In their article, Christian Eichner et al. [7] describe an approach to find hidden data features with regard to the user interest. For this, the users have to specify the data characteristics of interest. These features are then automatically detected and appropriately visualized. This enables the users to comprehend key characteristics of their data beyond low-level details. Such an approach is particularly important for cases in which large high-dimensional

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data in a 3D spatial context is generated. Hence, the authors illustrate their approach for the analysis of simulations in the biochemical domain. For this, they developed a multi-view, multi-display implementation to be utilized in a smart meeting room.

Analysis questions arising from a concrete application domain motivate the article by Halldor Janetzko et al. [8], who seek to improve the regulation of power consumption through Visual Analytics methods. The authors look at this issue on the level of commercial buildings. They argue that administrators have to understand energy consumption (especially anomalous values) before being able to introduce measures to reduce energy consumption. They describe a novel unsupervised anomaly detection algorithm and then discuss several possibilities how to visualize found anomalies in the context of the gathered power usage data. These directly communicate time and place of unusually high power consumption as potential targets for saving energy or probable conditions of failure.

Along the same lines, the article by Junghoon Chae et al. [9] addresses a relevant application scenario, as the authors aim at providing decision makers with information about disasters, such as hurricanes. This information is derived from microblog data, i.e., Twitter feeds, and analyzed with a tailored Visual Analytics approach. One of the challenges in this context is the fact that huge amounts of textual data have to be processed in time and space. In contrast to other researchers, the authors do not target the content of microblog messages but their metadata. From this they can, for example, learn about the progress of evacuation procedures and of recovery efforts.

The contributions to this special section of Computers & Graphics on Visual Analytics cover a broad range of topics. They have to deal with the complex nature of data that comes with real-world problems, such as heterogeneous data or spatio-temporal data, as well as the demands of diverse user groups. Consequently, the presented solutions span the breadth of this research field from the integration of the human in the loop via the tight coupling of automated analysis and interactive visual exploration to solve real-world problems. In this context, the invited and selected articles form a veritable cross-section of novel solution approaches towards these challenges.

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