The Impact of EuroVis Publications

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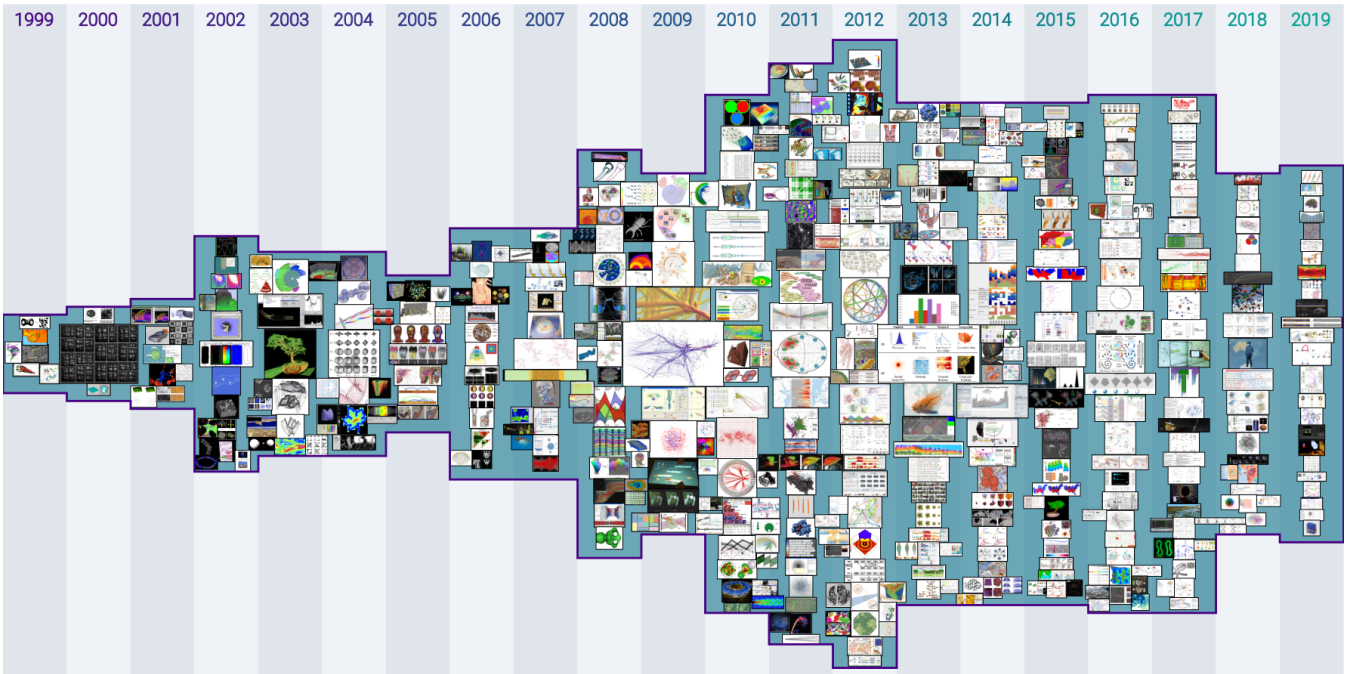

Figure 1: *Timages chart showing images representing one out of 469 EuroVis publications each having an age weighted index of at least 2.*

Abstract

EuroVis has been a symposium held in Europe annually from 1999 to 2011, and from 2012 on it is a conference organized by the Eurographics Working Group on Data Visualization and supported by the IEEE Visualization and Graphics Technical Committee (IEEE VGTC). As EuroVis counts as one of the major events in the scientific landscape of the visualization domain, the works published in the past 21 years have had and continue having a significant impact on current research endeavors. This work provides a pictorial overview of the temporal development of visualization techniques presented at EuroVis as full papers that gained most importance, and it sheds a light onto the most cited works.

1. Introduction

There has been several approaches to quantitatively display and explore the body of visualization research. Typically, metadata such as the keywords [IIS*17, YYQ17] or authors of papers [IHK*17, DNP19] prepare the ground for time-dependent analyses. Isenberg et al. [IHK*17] further provide an egocentric view on the relevance of an individual author to the visualization community. We borrow this idea, but instead of authors, we reflect the relevance of the most impactful techniques being promoted in visualization publications pictorially on a timeline (see Figure 1). To the best of our knowledge, such a time-dependent visual exploration has not yet been made possible. To appropriately reflect the impact of an individual publication, we weighted the citation count (as of February 2020) with respect to the publication's age in years. We therefore chose

to calculate the age-weighted citation index (AW-index) for all full papers accepted at the past 21 EuroVis symposiums and conferences, which is the number of citations divided by publication age in years. This way, we could acknowledge a publication's resistance to age. Other methods do not directly relate to the age of the publication, but more-so towards the pre-exisitng impact of the author, the number of authors involved, etc. [Fra09]. We considered visualization papers having an AW-index of at least two as impactful. For the resulting 469 publications, we extracted representative images, and adapted Timages [Jän18] to expose the temporal development of relevant visualization research. The impact of a publication is reflected by its image area that is determined according to the respective AW-index. The resulting Timages chart allows us to briefly discuss how EuroVis has evolved and what works important for the visualization community it has brought forth.

2. Historical Overview

As technology advances, data visualization research follows suit. The Timages chart in Figure 1 reflects this as EuroVis publications often reflect current technological trends and advances. We observe three different periods.

In the first years of EuroVis an apparent influence from techniques like volume rendering and heat maps is visible. Volume rendering, a 2D projection of a 3D discretely sampled data set [IO16], combines scientific visualization with computer graphics, and a large variety of algorithms and visualization techniques have been developed. Influential volume rendering algorithms surfaced during the late 1980s and continued to gain momentum in the mid-late 90s, e.g., re-sampling or shear-warp, texture slicing, and splatting [MB05]. The Timages chart indicates that EuroVis commits to the importance of volume rendering by arranging sample pictures of different volume rendering techniques up until 2006 [RGW*03, BGKG05, TIP05]. Volumes are often colored with a heat map using a transfer function to reflect object features like density. Software engineer Cormac Kinney was one of the first using heat maps to visualize real-time information about financial markets [NPS18]. Over the years, this coloring technique has been widely adopted in diverse visualization scenarios, and its influence reverberated amongst EuroVis publications from 1999 until 2006. Both techniques show the thematic focus on scientific visualization in the early EuroVis years. However, the information visualization technique Squarified Treemaps [BHW00], an extension of Shneiderman's Treemap [JS91], was the most impactful publication in that era. It received a citation count eleven times greater than the average citation count for other notable papers from 2000, consistently receiving an average of 48 annual citations from 2007–2018.

A thematic focus shift from scientific to information visualization is depicted in the Timages chart. From 2007 on, more and more related techniques gained significance in the field. Recurring techniques between 2007 and 2012 are radial layouts such as Docuburst [CCP09] for textual and TimeRadarTrees [BD08] for relational data, parallel coordinate representations [MM08, BPFG11] and graph visualization techniques [HET12, Dwy09]. The most impactful EuroVis year is 2009, as it brought forth the most publications with an above-average citation count complemented by a high AW-index. This year was a dynamic time for the creation of data

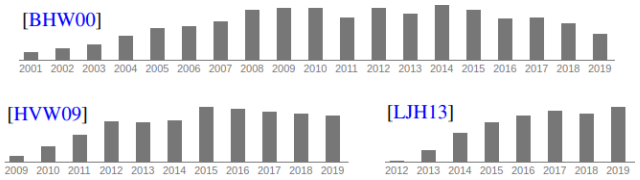

Figure 2: *Yearly citation developments of the three most impactful EuroVis publications.*

visualization applications and tools for the casual user, and it also introduced larger access to public APIs. With this dynamic growth period came the most influential EuroVis publication by Holten and Van Wijk [HVW09], who proposed a new edge bundling method for general graphs that works without any control mesh or hierarchy. The paper reaches an AW-index of 53, and it keeps on being important as it continues to receive an average of around 60 additional citations annually (since 2015). During our analysis, we recognized that the resistance to time-weighted relevance is a common theme among notable EuroVis papers (see Figure 2).

The introduction of *big data* has put pressure on data visualization tools to quickly adapt in various ways to handle large data sets [HM12]. From 2013 on, EuroVis featured more and more publications supporting the visual analytics of large data sets. This is reflected by the second most impactful EuroVis publication on real-time visual querying of big data [LJH13], receiving around 348 citations until now, which results in an AW-index of 49. But also dashboard systems [MSFM16, KTW*13] and design studies [LFK*13, CCH*14, KKTD17] document the focus to support big data analytics carefully designed for targeted user groups. This third period also highlights the current focus on immersive analytics [WFFN18, YJD*18].

All in all, the composition of most impactful visualization techniques in the past 21 years of EuroVis documents the diversity of data types—volume, textual, temporal, geospatial, relational—for which visual representations have been developed to support interactive analyses. The apparent ditch in impact in the past two years is likely related to the slowly rising citation numbers typical in the first years after publication (see Figure 2).

3. Summary

We offer a pictorial approach to analyze the importance of full paper publications and trends in the entire body of works presented at EuroVis, beginning in 1999 when it turned into a symposium. The storyline of our historical overview is shaped according to the information reflected by this pictorial representation. Most important publications are vertically centered and stick out through image size. Further, it is evident that images of representative visualization results extracted from the publications thematically cluster.

An interactive tool is online accessible to all interested researchers [Jän20]. It offers filtering by author and keyword, and clicking an image links to the respective entry in the Wiley Online Library. An interesting extension would be a pre-processing of topics derived from the paper contents, which could serve to group the images of thematically similar papers closely.

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