

Otto-von-Guericke University Magdeburg



Master Thesis

Thesis Proposal

Working Titel

A Descriptive Characterization of Interactive Data-Driven Visual Storytelling in a Spatio-Temporal Context

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Master Informatik

Version 2

28.03.2022

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1. Motivation

Stories accompany us every day. They are used to communicate and present complex content effectively and in an engaging way. In the age of digitalization, data is increasingly becoming an important part of storytelling, especially in the fields of graphic design, the advocacy of causes and journalism (Stolper et al., 2016). With the realization, that the resulting narrative visualizations support understanding the message of stories, the number and development of new used techniques rises. More and more Storytellers of web-based spatio-temporally bound stories also make use of narrative visual techniques, as they help to relate an action to familiar places and to better understand the temporal sequence of events (Mayr&Windhager, 2018). However, visualizations with spatial reference are based on a two-dimensional structure, which is why the temporal component often cannot be applied as a linear axis. Instead, linearity is integrated through the way the story is told (Roth, 2021).

2. Problem Definition and Research Question

Related work has either given little attention to the particular structure and techniques of spatio-temporal narratives (Tong et al., 2018; Bach et al., 2018) or focused mainly on broader map-based visual storytelling genres and design patterns (Roth, 2021). Therefore, similar to Stolper et al. (Stolper et al., 2016) but specifically for spatio-temporal data, it is interesting to explore what current detailed narrative storytelling techniques (e.g., mechanisms and operations), visualization components and stylistic means exist on the internet in this regard (from 2016 until today). In doing so, I will be guided by the visual storytelling genres presented by Roth (Roth, 2021) and I will consider the time component in space using the Design Space of Mayr and Windhager (Mayr&Windhager, 2018). I will combine these two works with appropriate categories of Stolper et al. (Stolper et al., 2016) to an updated taxonomy and embed recent, web-based techniques of spatio-temporal data stories.

3. Related Work

3.1. Categorizations and Design Spaces of Visual Storytelling Techniques

Segel and Heer (Segel&Heer, 2010) have developed a design space of different genres of narrative visualizations and thus laid a starting point for much research in the field of visual storytelling. **Lee et al. (Lee et al., 2015)** defined the characteristics a story must have to be called a visual data story and identified the roles in narrative visualizations. In the last decade, further work has followed, dedicated to the aim to advance the study of narrative visualization. **Stolper et al. (Stolper et al., 2016)** have developed a taxonomy that classifies web-based, data-driven stories according to visual storytelling techniques such as navigation or linking. **Tong et al. (Tong et al., 2018)** examined important elements in storytelling visualization and **Bach et al. (Bach et al., 2018)** categorized design patterns of data-driven narratives, that aid to provide guidance and structure. Recently, **Yang et al. (Yang et al., 2021)** have published a paper where they propose a design space for creating structured data stories based on the narrative structure *Freytag's Pyramid*.

From a more specific view, we find further work on the contribution of different design spaces in narrative visualisation techniques, such as for:

- Transitions between common statistical data graphs by **Heer and Robertson (Heer&Robertson, 2007)**

- Effective sequences in a series of linearly presented visualizations by **Hullman et al. (Hullman et al., 2013)**
- Chart annotations by **Ren et al. (Ren et al., 2017, April)**
- Timelines by **Brehmer et al. (Brehmer et al., 2017)**
- Different visual narrative flows by **McKenna et al. (McKenna et al., 2017, June)**
- Types of infographics in online long-form journalism (scrollytelling) by **Seyser and Zeiller (Seyser&Zeiller, 2018, July)**
- The interplay of visualizations and textual narratives in geographic data-driven stories by **Latif et al. (Latif et al., 2021, June)**

Building on these works, I aim to develop a taxonomy that categorizes current techniques of web-based spatio-temporal visual stories regarding detailed mechanisms and operations, genres and time representations.

3.2. Visual Storytelling of Spatio-temporal Data

Mayr and Windhager (Mayr&Windhager, 2018) created a visualization framework based on standard techniques for representing spatio-temporal data to support their analysis. They compiled these standard techniques from a variety of related works in the research area, including static and animated maps, space-time cubes, and coordinated linked views.

For example, **Hsu et al (Hsu et al., 2018)** developed a web-based timelapse editor for creating guided video tours and interactive slideshows of spatial and temporal images and **Eccles et al. (Eccles et al., 2008)** as well as **Kraak and Kveladze (Kraak&Kveladze, 2017)** added story elements to the space-time cube (STC) visualization, increasing the expressiveness of the representation. **Roth (Roth, 2021)** proposes a design space for map-based visual storytelling and **Lundblad and Jern (Lundblad&Jern, 2012)** have developed the toolkit GAV Flash and the user application “World eXplorer” to create and share stories of spatio-temporal data. Furthermore, **Biriukov (Biriukov, 2021)** provides a classification of techniques of interactive storytelling maps along with helpful tools and libraries as development guidance.

Using existing genres and design spaces for spatio-temporal visual storytelling aids as guidance for formulating an adjusted, more detailed taxonomy that summarizes and categorizes current techniques for this context.

4. Tasks, Procedure and Methodology

For the analysis, I will explore a collection of web-based, narrative visualizations of spatio-temporal data. Inspired by related works, the analysis will especially focus on online magazines such as: *New York Times*, *The Guardian*, *The Washington Post*, *The Economist*, *FiveThirtyEight*, *Bloomberg Visual Data*, *National Geographics* and *Zeit online*. Furthermore, related works indicated further websites and blogs such as *FlowingData*, *Gapminder*, *visualizing.org*, *visual.ly*, *Tableau Public*, *Reuters Graphics*, *Infogr.am* and *EagerEyes* (McKenna et al., 2017, June; Stolper et al., 2016; Ren et al., 2017, April; Hullman et al., 2013; Brehmer et al., 2017). If it is suitable, also samples are to be taken from these sources.

The samples will include visual stories that are *author-driven* and thus exclude extreme *reader-driven* stories without author guidance as described by Lee et al. (Lee et al., 2015). However, I would like to consider visual stories that integrate at least one interactive component that goes beyond clicking the play button in an animation/video (e.g. scrolling, selecting,...). Thus, the advantages of

interaction - as we can see for example in the narrative design patterns from Bach et al. (Bach et al., 2018), such as *Familiarization*, *Make-a-guess* or *Users-find-themselves*, that stimulate curiosity and engagement and make abstract data personally relatable - can be taken into account and support the message of the story.

With this in mind, I will be guided by the following visual storytelling genres from Roth (Roth, 2021): *Longform Infographic*, *Dynamic Slideshow* and *Multimedia Visual Experience*. I want to exclude the *Personalized Story Map*, the *Static Visual Story* and *Narrated Animation* genres, since they either allow unguided, personalized navigation, or they do contain too little or no interaction. Furthermore, I want to exclude the *Visual Story Compilation* genre, since the story consists of a string of several single stories and therefore the author has little influence on the narrative element composition.

The research and collecting process should last approximately the first two months of the thesis term. It also includes the ordering, sorting and classification of the samples from the large pool of samples collected. The classification will be inspired by the taxonomies and Design Spaces published in related works. My main reference will be the taxonomy of Stolper et al. (Stolper et al., 2016), so that I can propose a broad overview of applied techniques for the specific case of spatio-temporal data, on which further work can build in detail. In the course of the research I will investigate which of Stolper et al.'s categories are appropriate for my work, which can be changed or possibly omitted (based on the selected genres of Roth's work (Roth, 2021)). In addition, following Mayr and Windhager (Mayr&Windhager, 2018), I will examine techniques to visualize time in space that are increasingly used on the internet.

Subsequently, only a small representative part of the story samples will be selected, which best reflect the categories. Based on these categories, a taxonomy will be created that clearly represents each category with its examples. For the programming part, I will visualize this taxonomy in a tool to explore minimal examples for the individual categories.

This first version of the taxonomy will then be checked with experts from the Chair of Visualization at Otto-von-Guericke University Magdeburg.

5. Goals and Expected Benefit

Based on a collection of recent data-driven stories (2016 until today) from online journalism and other visualization websites, this thesis will examine, analyse, and classify the techniques of visual storytelling of spatio-temporal data according to detailed mechanisms and operations. Thus, I aim to reveal how current storytellers realize the time component in space, the connection and explanation of narrative elements, and the navigation and interaction in the spatio-temporal context. This shall serve as guidance and inspiration for future storytellers to effectively present visual spatio-temporal data stories and as basis for future research in this aforementioned field, which might tie in with certain techniques in detail (e.g. How is a story opened/closed in this context?).

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