Global Illumination for Fun and Profit

Roy G. Biv, Ed Grimley, *Member, IEEE*, and Martha Stewart



Fig. 1. In the Clouds: Vancouver from Cypress Mountain

**Abstract**—Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exercit­ation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulpu-tate velit esse molestie c­onsequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blan-dit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Ut wisi enim ad minim veniam, quis nostrud exercit­ation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulpu-tate velit esse molestie c­onsequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blan-dit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi.

**Index Terms**—Cinematography, virtual worlds, virtual environments, camera placement, hierarchical finite state machines

# Introduction

It is widely accepted that advanced visualization techniques are effective for data analysis. [1][2][3]By introducing metaphor borrowed from nature[4], applying carefully designed layout algorithm, ,sophisticatedly combine existing visualizations, these novel visual presentations help people to identify data correlation and find the stories hidden beneath.

However, these advanced visualizations are usually not intrinsically recognizable. Users need to go through a tedious trial, most of the time, reading the long, boring textual description in a research paper, before they grasp the knowledge required to understand and freely explore a visualization.

What is more, even people inside visual community suffer when they are required to explain advanced visual design, especially when the visual encoding has complicated logic dependency, or when their audience have little prior knowledge about visualization techniques.

As a result, these advanced visualization technology, in spite of the fact that their utility has been verified by domain experts from various fields, gain little exposure outside visual community. It is still these naïve visualizations, such as bar charts, pie charts, that dominate in main stream media.

* Roy G. Biv is with Starbucks Research. E-mail: roy.g.biv@aol.com.
* Ed Grimley is with Grimley Widgets, Inc.. E-mail: ed.grimley@aol.com.
* Martha Stewart is with Martha Stewart Enterprises at Microsoft Research. E-mail: Martha.stewart@marthastewart.com.

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For a visualization, its design space can be described as the orthogonal combination of two aspects: graphical elements called marks and visual channels to control their appearance.[5]Why the explanation of these two things are so complicated? First, there is always some logic dependency among visual elements. For example, the topic streams of a theme river should be explained before the keywords mapping upon them, otherwise the audience will get totally lost. Secondly, visual distraction from unrelated items can hinder understanding since object identification requires the support of focused attention. [6][7] For example, color can be an strong distractor when people try to focus on their shape. [5] What is more, people are easy to lose focus as well as to forget what has been told before.

Thus, a specific order of encoding explanation and an attention guidance to follow such order become necessary. Attention guidance and reminder are also needed to make sure the audience keep focused and don’t forget previous information.

Narrative has long been used to share complex information. As defined by the oxford dictionary, it is “an account of a series of events, facts, etc., given in order and with the establishing of connections between them.” As the data visualization field becomes more mature, many researcher move their focus from analysis to presentation, drawing increasing attention to narrative visualization.[8] Many efforts have been taken to define, classify, and provide advice for narrative visualization design. [9] [10] [11] However, current works mainly focus on communicating the conclusion of analyses, rather than guiding the audience how to read a visualization.

Here, we presented a prototype to adopt narrative techniques to visual encoding explanation. A web-based authoring tool is built to decompose a visualization, reorganize extracted visual elements in a pre-defined logic sequence, and explain their visual encodings through animated transition one by one in the form of slideshow. A detailed description about visual element extraction and reorganization is in section XXX. Through a narrative sequence, only limited information is added each time so the audience won’t get overloaded. Reminders, such as questions, summarizations, repetition are inserted into the sequence to enhance audience’s memory while visual attention guidance, such as flickers, highlight, morphing are insert to lead their attention to newly added information.

To the best of our knowledge, this is the first attempt to explain visual encoding with narrative techniques. We believe we have the following contributions:

1. Analysis of the structure, logic dependency, and visual distraction existed in a visualization design
2. Algorithm to extract visual elements and their corresponding text explanation from an infovis paper
3. Apply narrative techniques, namely, animated transition, attention guidance, memory recaller, for encoding explanation
4. Build-in blocks for common visualization explanation
5. An web-based authoring tool to generate and edit narrative visual encoding explanation

This work is only a prototype. The build-in blocks we present at this point are unable to cover all types of visualization. But we believe, as more and more users contribute the blocks they build themselves, the performance of this tool will be quickly improved.

This tool can also be embedded in data analysis tool as a tutorial with minor adjustment. We conjecture our work can motivate and enable people to use more advanced visualization designs.

# related work

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## Subsection One

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# three levels of structure

We analyse the composition of a data visualization and divide it into three levels of structure: visual primitive, visual unit, and visual sum. A visual primitive is a graphic element (called as mark) with the visual channels controlling its appearance. (e.g. in a node-link diagram, node and line are visual primates.) A visual unit is one visual primitive or the combination of several visual primitives. (e.g. a bar chart is one visual primitive, rectangle while a node-link diagram is the combination of two visual primitives, node and line.)

# decomposition algorithm

# system and interaction

# case study

# evaluation and discussion

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Fig. 1. Two boxes. One filled with confetti.

## Subsection One

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| Table 1. Vis Paper Acceptance Rate | | | |
| Year | Submitted | Accepted | Accepted (%) |
| 1994 | 91 | 41 | 45.1 |
| 1995 | 102 | 41 | 40.2 |
| 1996 | 101 | 43 | 42.6 |
| 1997 | 117 | 44 | 37.6 |
| 1998 | 118 | 50 | 42.4 |
| 1999 | 129 | 47 | 36.4 |
| 2000 | 151 | 52 | 34.4 |
| 2001 | 152 | 51 | 33.6 |
| 2002 | 172 | 58 | 33.7 |
| 2003 | 192 | 63 | 32.8 |
| 2004 | 167 | 46 | 27.6 |
| 2005 | 268 | 88 | 32.8 |
| 2006 | 228 | 63 | 27.6 |
| 2007 | 216 | 56 | 25.9 |
| 2008 | 197 | 50 | 25.4 |

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# Conclusion

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