Designer-critiqued Comparison of 2D Vector Visualization Methods: A Pilot Study

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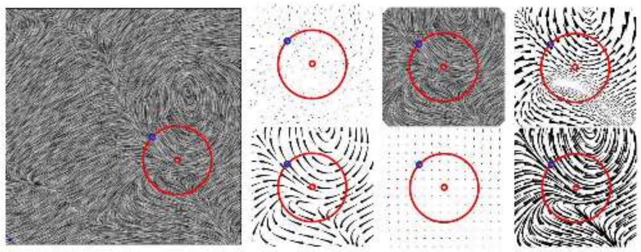

Figure 1. The six visualization methods the designer critiqued. The large image shows a full screen shot. The other six are details from each method (clockwise from top-left: JIT, LIC, LIT, OSTR, GRID, GSTR). The circles represent an advection task used in a previous study [Laidlaw et al. 2001]. Observers were asked to indicate where a particle in the flow, starting at the small concentric circle, would intersect the large concentric circle; the other circle represents the correct intersection point.

	GSTR	JIT	LIC	LIT	OSTR	GRID
Accuracy						
Designer	A-	D	B-	B+	A	C-
Prev. Study	1.3%	4.5%	19%	3.5%	0.9%	4%
Time						
Designer	A-	D	B-	B+	A	C-
Prev. Study	3.5 s	3.5 s	5.0 s	3.5 s	3 s	3.5 s

Table 1. Scores given for the six visualization methods from designer critique and the previous user study [Laidlaw et al. 2001] for the advection task (see Figure 1). Accuracy for the user study is given as error rate and time for task completion is in seconds.

1 Introduction

Evaluation of scientific visualization methods is typically either anecdotal, with feedback from scientific users, or quantitative, with performance measured on simple abstract tasks performed by relatively naïve users. While scientific users can provide domain-specific feedback, neither population is typically trained to provide visual-design feedback.

The current pilot study examines how expert graphic design knowledge can provide a fast and robust visualization evaluation methodology, one that assesses scientific visualizations for their scientific value while also improving the design and composition of the visualizations. Since graphic designers, particularly illustrators, are trained to judge how well visual designs convey specific pieces of information, we believe they can evaluate scientific visualizations for how well they fulfill design goals based both on the scientific task represented and the actual visual design.

2 Our Approach

In a previous user study [Laidlaw et al. 2001], we quantitatively evaluated several 2D vector field visualizations. We proposed three tasks to understand the flow in a bounded 2D vector field. For each task, we measured the accuracy and execution time for each observer. We found that particular visualization techniques were more suited to certain tasks than others.

We will have designers grade scientific visualization methods based on their subjective estimates of user performance for certain tasks, and give verbal feedback (i.e., critique) on the effectiveness of each method for fulfilling these tasks. We hypothesize that designers will rank the methods similarly to objectively measured task performance. We also believe that the critiques will enable us to understand why methods work well and to synthesize better visualization techniques. This will enable us to identify which elements of these methods work best for the given tasks.

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3 Pilot Study

One designer gave grades to the visualization methods as an estimate of user performance for an advection task on two data sets with each method. He first ran through the previous study as training to understand the advection task. We then presented him two sets of images like the ones in Figure 1. We recorded his comments about the visualizations during his critique. He thought that the JIT method was the "worst" of the six techniques because its visual elements were "too small." He stated that the OSTR method was the "best," partly because it was "not too busy" in terms of the density of the visual elements. He also stated that this method gave the "least 3D sense," which was good since this could confuse the interpretation of the data. The designer also commented on the other four visualization methods. We show the results of this critique along with the results from the previous user study in Table 1.

4 Discussion

A visual design professional analyzed the perceptual and compositional characteristics of several visualization methods with respect to certain scientific goals. We found that his subjective estimates of user performance were similar to previous quantitative performance measures. We also recorded his comments concerning the elements of each method. We conclude that using this type of evaluation will give us a knowledge base to generate new and improved visualizations quickly and with better chances of success.

Acknowledgements

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References

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