Static and Dynamic Visual Mappings to Explore Bivariate Data Across Time

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Time and time-oriented data are pivotal for many Visual Analytics scenarios [AMST11]. In principle, the time dimension can be represented using the display space (static mapping, e.g., line plot) or physical time (dynamic mapping, e.g., animation). Dynamic mapping is more direct and, thus, a promising visual metaphor. However, there are contradicting results on its effectiveness for analytical reasoning [RFF*08]. To explore the mutual behavior of two variables, the most popular visual method is probably the scatter plot. However, an individual scatter plot is only a static snapshot of the relationship of two variables and developments over time cannot be seen. Hence, time can be added either using an animated scatter plot [RAM*11], or by repetition (small multiples [Tuf83]). Moreover, with small multiples either states or changes over time might be emphasized.

To gather empirical evidence about the advantages and disadvantages of these different approaches, we developed a Visual Analytics prototype (Figure 1) and conducted a comparative user study [Neu12]. The prototype affords sophisticated user interaction on the time dimension in addition to common interaction techniques such as zoom, select, and filter. Users can watch the animated scatter plot as a movie or wiggle the time slider to navigate proactively. With small multiples, they can set the temporal granularity, by which the data is split into subintervals, and the aggregation method, if more than one observation occurs in a subinterval. Furthermore, they can activate traces to emphasize change.

In our user study, we compared three visual mappings in terms of time and errors: Animated scatter plot, small multiples, and small multiples with traces. For this, we limited the functionality of the prototype and only showed one mapping at a time. Preliminary results from the post-study questionnaire indicate that the subjects preferred animated scatter plot and that they found it most understandable and usable.

In future work, we are going to analyze the quantitative data and interaction logs collected in the user study. Furthermore we plan an insight study using the same Visual Analytics prototype in a less controlled setting.
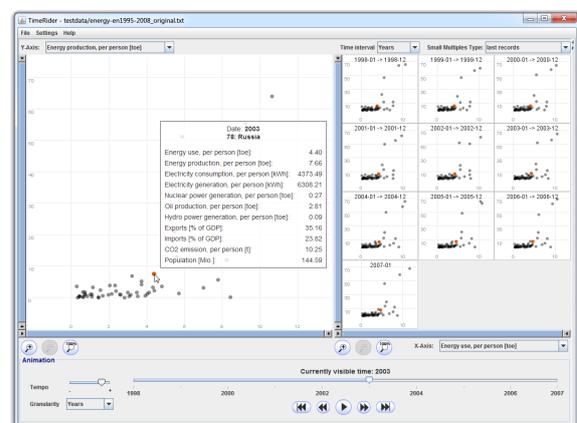

Figure 1: *User interface with animated scatter plot (left) and small multiple scatter plots (right)*

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