Micro-Macro Views for Visual Trajectory Cluster Analysis

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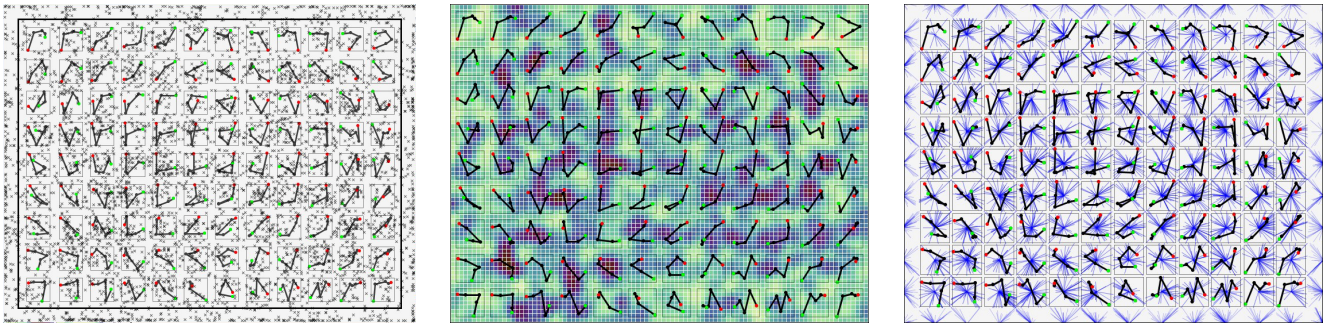

Figure 1: *Combined macro (cluster) level and micro (sample) level views are proposed to support visual cluster analysis in trajectory data. The developed* Scatter *(left),* density *(middle), and* star *micro views superimpose sample-level information on the overall cluster structure.*

1 Introduction

Visual cluster analysis aims to support analysis of large data sets by visualization of clusters learned from the data. The cluster abstraction is often helpful for data understanding, and many visualization techniques support visualization of clusters. However, in many cases also the individual data samples and their relationship regarding the learned clusters are of interest. Inspired by Tufte's notion of *micro-macro displays* [Tufte 1990], we present an approach combining the visualization of both the cluster (macro) and the data sample (micro) level in one single view.

2 Our Approach

In [Schreck et al.], we considered visual cluster analysis of trajectory data using the Self-Organizing Map (SOM) [Kohonen 2001] algorithm. Our original approach is based on visualizing cluster prototypes as arranged on the SOM grid using trajectory forms. We consider this view the macro view, as it shows a small number of cluster prototypes. Due to a typically rather low number of prototypes to be displayed, the available display space can effectively be used to visualize each prototype by a native representation of the underlying data objects (trajectories in our case).

We currently work on extending that base macro display by a micro view showing also the distribution of data samples in respect to the location of the cluster prototypes. We achieve this by refining the given SOM grid to a higher-resolution grid on which to map the data samples. For each high-resolution grid cell we interpolate between the SOM prototype vectors using a Spline interpolation scheme. Samples are then mapped to that high-resolution grid by finding nearest neighbors. Due to the higher number of samples as compared to the lower number of cluster prototypes, we visualize the sample positions using more space efficient representations (currently, we consider scatter and heatmap representations).

The obtained high-resolution grid is the basis for a number of micro-views we designed for overlay over the macro trajectory cluster view. In particular, we implemented the following views.

- The *scatter* view (cf. Figure 1(left)) shows the distribution of samples (according to Spline interpolation) in relation to the trajectory clusters using a dot representation.
- The *density* view (cf. Figure 1(middle)) visualizes the sample distribution density in a colorcoded heatmap representation.
- The *star* view (cf. Figure 1(right)) indicates for each sample the nearest cluster prototype on the coarse grid.

These micro views can be dynamically selected by the user for overlay over the macro cluster view. Main parameters of the approach (e.g, refinement resolution, color mapping normalization options, etc.) can be interactively controlled by the user.

The micro views allow a fine-granular analysis of the distribution of samples in terms of the overall cluster structure as learned by the SOM algorithm.

3 Conclusion and Future Work

We proposed to extend cluster-oriented SOM visualization by overlays including also the distribution of data samples in relation to the cluster centers. We currently experiment with different views based on scatter plots, density heat maps, and nearest neighbor connectors. These views are part of a larger system aiming to provide encompassing visual-interactive control in trajectory data cluster analysis. Future work will explore other forms of visual representation of the micro level, and think about ways to more tightly integrate both levels.

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References

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