GPU Based Graph Bundling Using Geographic Reference Information

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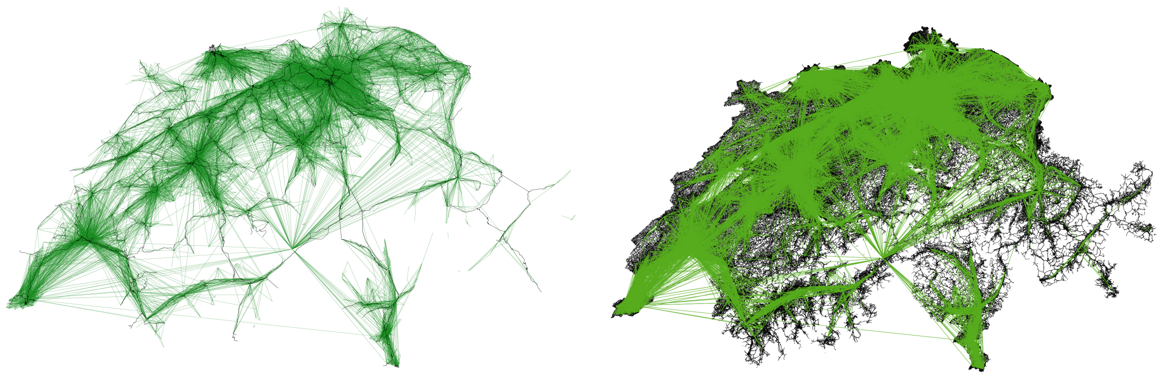

Figure 1: *The Swiss commuter dataset (green), containing 31609 lines and 2886 vertices, shows the commuters within Swiss communes. The underlying geographic reference data shows the Swiss railroad network (left) and the Swiss VECTOR25 street map (right)*

1 Introduction

A common source of challenges in geographic visualisation systems is the growing amount of available data. Datasets containing different information need to be merged and analysed under a common context. For some purposes these datasets can interact intelligently and append additional information to a scientific visualisation. In this research proposal, we show how we are planning to optimize the process of bundling graphs to traffic networks and present a general method to solve this challenge.

Bundling of graph information is a common problem in information visualisation. The approach of bundling a graph according to geographic coordinates is described in [Lambert et al. 2010] and shows that much more visual information could be extracted from already available datasets. The force directed graph bundling described in [Holten and van Wijk 2009] uses forcefields to attract subdivided lines to each other and will be used to compare the visual results of the final product. Geometry-based graph bundling [Holten 2006] uses spatial structuring to improve the performance in graph bundling and was an inspiration for using spatial data structures within geograhic information.

The following set of requirements describes the research target of our graph bundling method. First, to incorporate a feature within an existing 3D visualisation that is able to link two datasets, one containing point to point information and one containing a reference network, so that the point to point data is bundled to streams according to the reference information. Second, to reduce remaining clutter in the resulting images so that it is possible to clearly identify these streams. Finally, to allow the user to be able to identify single features within a single dataset.

Figure 1 is an example for the need of clutter reduction. It is almost impossible to extract detailed visual information about commuter-streams from these images. Bundling the streams will lead to a visualisation, which makes it easier to read the connections. However, there are other hidden aspects, e.g. which roads the commuters use most. Furthermore, it is necessary to be certain that datasets are not crossing through other scene objects.

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2 Our Approach

In our approach, bundles are streamed according to a reference traffic network, like roads or railroads. The result is the visual feedback on how many commuters influence the traffic on any single road. In addition, the streamlines are specified to follow more realistic paths.

As a first step, the traffic network is processed to a graph network, which contains street crossings and simple representation of lines. The traffic network can be simplified, because only the adjacency information is needed.

As a second step, the information about where a commuterline starts and ends is extracted. For this purpose we take the graph from the traffic network, build a KD-tree based on these points and search within this KD-tree the nearest graph node for all start and end points of the commuterlines.

Using this information, we can perform a shortest path search for every commuterline based on the simplified reference graph. The resulting path is connected with the start and endpoints of a single commuterline and describes the path of one single commuterline. An advantage of this processing method over other graph bundling approaches is, that until this point the information remains in 3D and is not rasterized, and can be used for further processing. It is also possible to use the resulting path as basis for a spline rendering or other curvature representations.

References

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