Abstract

The metro map is a well-known type of diagram that is widely used in illustrating transportation networks. Metro maps incorporate a carefully balanced trade-off between accurate geographical representation of the network and ease of understanding of the diagram. Traditionally, metro maps are drawn manually. It is a significant challenge to create algorithms that produce metro maps automatically; in general, existing visualisation methods are not able to produce such diagrams.

This thesis explores a number of problems motivated by the challenge of automatically drawing metro maps. We first look at metro map layout as a graph drawing problem. In this case, a graph is given, and the desired output is a drawing of the graph that exhibits certain aesthetic properties observed in existing metro maps. We propose modifications to some existing force-directed graph drawing algorithms for this purpose. This method does not assume the presence of any geography in the network, i.e. it may be used to draw any kind of graph in the style of a metro map.

In the presence of geography, as is the case in real transportation networks, we investigate the problem of schematisation. We define schematisation to be the process of taking a geometric graph and redrawing it using only line segments in a restricted number of orientations. We look at problems of path and tree schematisation, in which we want to schematise a path or a tree such that the number of line segments in the schematisation is minimised, but the distance from the schematisation to the original geometry is bounded by a given error. Algorithms are given to solve a number of variations of these schematisation problems.

Schematisation may be considered as a specific type of cartographic generalisation. Generalisation is well studied in various forms, but more recently there has been a focus on preserving important cartographic characteristics of features on a map, rather than just geometric distances. In the final part of this thesis, we explore the problem of maintaining such features in an interactive map system, where a user is not limited to viewing the map at certain pre-defined
scales, but can change the scale continuously. We give a morphing algorithm that is used in conjunction with existing generalisation techniques to do this, and show the results of applying it to a road network.