



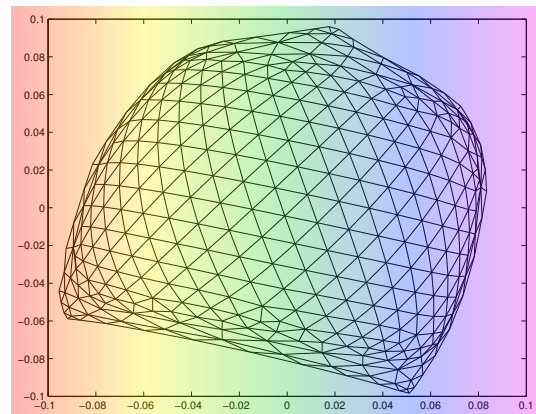
SGT Toolbox – A Playground for Spectral Graph Theory

This document describes the subject and the general time schedule of the Master thesis of *Michael König* in the autumn term 2011. Adaptations or changes can be agreed upon by the advisors.

Motivation and Informal Description

Spectral Graph Theory (SGT) studies the connection between extrinsic properties of a graph and the eigenvalues and eigenvectors of matrices associated to the graph such as the adjacency matrix or the Laplacian matrix. The applications of SGT are manifold. For example, it can be used to derive canonical embeddings of planar graphs. This *spectral embedding* can then be used to find out whether two given graphs are isomorphic.

SGT is a challenging research area, in particular because it is hard to gain intuition for the meaning of the eigenvalues/-vectors of the graph's matrices with respect to its graph-theoretical properties. The *SGT Toolbox* shall help to assist in this goal by providing a visual framework where users can input graphs through various methods (draw them, input adjacency matrices, etc.) and then analyse them with respect to their spectral properties. This comprises, of course, the calculation of eigenvalues/-vectors of the characteristic matrices of the graph. Additionally, the toolbox should display various spectral embeddings of the graph. Of



particular interest is how the eigenvalues/-vectors change if the corresponding graph is only slightly changed (removal of a node, perturbation of an edge weight, etc.) Hence, a crucial requirement for the application is to support dynamic changes of the examined graph. The toolbox should then be used to gain scientific insights about distributed algorithms (for example Luby's MIS algorithm, Spring Embedders) and help to analyse them using SGT.

Contact

- Tobias Langner: tobias.langner@tik.ee.ethz.ch, ETZ G61.4
- Barbara Keller: barbara.keller@tik.ee.ethz.ch, ETZ G61.2