ETH
Eidgenössische Technische Hochschule Zürich
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Lecture with Computer Exercises:
Modelling and Simulating Social Systems with MATLAB

Project Report

Trail formation with Physarum polycephalum of the Swiss rail network

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Agreement for free-download

We hereby agree to make our source code for this project freely available for download from the web pages of the SOMS chair. Furthermore, we assure that all source code is written by ourselves and is not violating any copyright restrictions.

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1 Abstract

As most of the countries, Switzerland is crowing. Cities are getting more inhabitants, growing together or arising new. With more people living in the cities and generally in Switzerland, more people will use the public transport system and the railroad network has to grow and develop. In this case, the main goal of this project is to simulate the Swiss railroad network depending on population growht to see where the systems should be improbed.
The network is simulated with a biological model, based on Physarum polycephalum. This slime mold is a large single-celled amoeboid organism that forages for food sources. To maximize the searched area, it explores it's environment with a relatively continous foraging margin. It's forming different junctions and nodes to reduce the overall length of the connecting network [2]. And this principle is adapted to the main transport lines in Switzerland.

2 Individual contributions

3 Introduction and Motivations

4 Description of the Model

The mathematical model is based on [1]. The urban areas (food sources) are the independent variables. By using theorems from hydro dynamics there exists three types of dependent variables for each node: conductivity, length and pressure.

As mentioned in [1], the flux prefers junctions with high efficiency (e.g. short connections). Because the flux in the system is constant, the junctions with high efficiency grow (getting thicker and more flux goes through), while the junctions with low efficiency shrink and disappear.

5 Implementation

6 Simulation Results and Discussion

7 Summary and Outlook

8 References

References

[1] Atsushi Tero, Ryo Kobayashi, and Toshiyuki Nakagaki. Physarum solver: A biologically inspired method of road-network navigation. *Physica A Statisticla Mechanics and its Applications*, 2006.

[2] Atsushi Tero, Seiji Takagi, Tetsu Saigusa, Kentaro Ito, Dan P. Bebber, Mark D. Fricker, Kenjo Yumiki, Ryo Kobayashi, and Toshiyuki Nakagaki. Rules for biologically inspired adaptive network design. *Science Magazine*, 2010.