Christoph Rieper and Benjamin Sunarjo

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Lecture with Computer Exercises: Modelling and Simulating Social Systems with MATLAB Project Report

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Group Name: Rieparjo

Group Members: Christoph Rieper and Benjamin Sunarjo

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.

Christoph Rieper

Benjamin Sunarjo

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Abstract

Individual contributions

1 Introduction

Agent-based models can provide a easily implementable way to study complex systems. As Helbing et al. (1997) have shown, many aspects of pedestrian motion, such as the formation of trail systems in green areas, can be reproduced using a relatively simple "active walker" model that takes into account the attractiveness of terrain and feedback on the terrain as it is walked upon. In the current project, we plan to apply such an active walker model to real landscapes and compare the results to existing road systems.

We attempt to answer the question: is the active walker model able to predict reasonable pathways between neighboring villages in real landscapes? Here, "reasonable" will be evaluated first in a qualitative sense. Second, a energy function will be defined based on the distance traveled horizontally and vertically, where a minimal energy function is most reasonable.

In a second step, we will determine the influence of landscape slope on trail formation, under the assumption that modern roads are situated where historically trails used to go through. We will compare generated paths to current road networks at two test sites to answer the questions: How does trail formation change with increasing landscape slope? Do the formed paths fit to current road networks?

2 Description of the Model

Theoretical work by Helbing et al. (1997) has previously been implemented in an agent-based model by Pfefferle & Pleschko (2010). We will base our investigation of the above research questions on this model, making adjustments where necessary. We will use topographical data from swisstopo.admin.ch with an emphasis on 1. determining reasonable model parameters and 2. comparing modeled trails to existing road systems. Two test sites are proposed, one in an mountainous region in St. Moritz, the other in the Swiss lowlands near Friburg (Figure 1). These two test sites provide very different types of terrain on which to study the problem of trail formation.

3 Implementation

We expect to find that the smaller roads correspond more closely to results generated by the active walker model, while larger cantonal roads, being further removed from their trail origins, should correspond less with model results. We further expect increasingly mountainous terrain to tightly constrain possible routes: we expect closer correlation between road systems and generated model results in mountainous regions than in the lowlands, since there are less possibilities for taking a route with low associated energy cost.

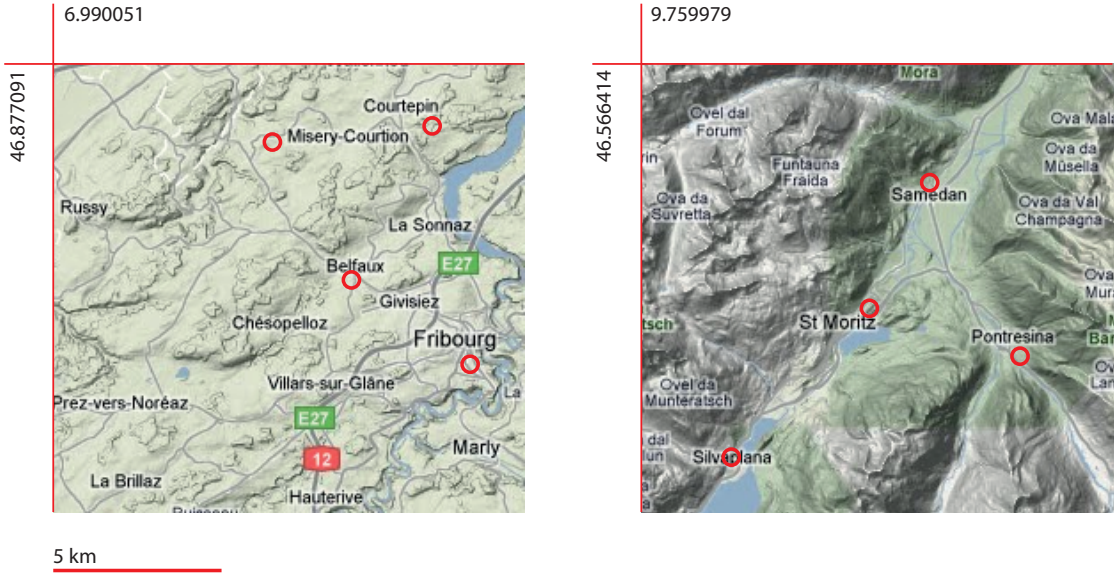

Figure 1. Two test sites, one mountainous one flat.

4 Simulation Results and Discussion

5 Summary and Outlook

References

Helbing, D., Keltsch, J., & Molnár, P. (1997). Modelling the evolution of human trail systems. *Nature*, 388(3).

Pfefferle, J. & Pleschko, N. (2010). Simulation of human trail systems. Project Report for Lecture "Modelling and Simulating Social Systems with MATLAB".