Scientific report of STSM-IC0903-9781

Research background

Our department of Geography at the University of Tartu have used mobile phone positioning data for few years now to answer different movement related research questions from various domains like urban geography, planning, tourism, etc. The scientific interest behind this data is to understand and get an insight of the human movements in order to make justified spatial decisions. Mobile phone positioning has developed rapidly and is rather cost-efficient methods in mobility data collection. Nevertheless, it is a large dataset that can not be effectively visualized without prior adjustment. Accordingly, my research focuses on finding alternative ways of visualizing this type of multivariable and dynamic dataset without causing over-potting and cluttering representations that is the main problem while using traditional cartographic methods like point density maps, flow maps, and choropleth maps that are currently most frequently used in mapping movement data from large datasets. The visualization method we aim to achieve should support the integration of different characteristics of movement like distance, direction, origin-destination points, spatial barriers, time, and give a simplified view of reality that supports solving movement related research problems.

The framework we are using in our visualization method development is based on chorem theory created by R. Brunet in 1980's. My research is focusing on the cartographic design issues of chorems. How to effectively combine cartographic knowledge with computing technology to produce computer driven visualization that is clear and well associated to human movements. The main objective is to design, develop, and evaluate chorems as a visualization method for human movement data.

The main purpose of my visit to the Faculty of Geo-Information Science and Earth Observation (ITC) at the University of Twente was to exchange ideas how to proceed with my research topic and search possibilities for the usability part of my research.

In more detail:

1) Discuss about the options how to integrate different visualization methods into chorems,
2) Get feedback on the visualization model structure worked out so far, evaluate its components and usage among other possible users besides our workgroup,

3) Work with literature to evaluate chorems usage over history in order to adjust the visualization method structure if needed to enhance its effectiveness and overcome possible misunderstandings,
4) Find out which methods and technology is available for usability research.

An overview of the work done during the visit and primary results

In short our visualization method development process involves data management, code writing to automate the chorem creation process, and finally an evaluation of the representation (how effective, efficient and satisfactory they are to users). During my visit I had several discussions with professor M.-J. Kraak about the advantages and disadvantages different visualization methods have. As a result a set of preconditions were outlined that concerns the graphical variables (like size, colour, texture etc.) and symbols (like lines, circles, rectangles etc.) that can be used as the model graphical components. Another aspect I want to emphasise is the dynamics of the movement process. Therefore, we looked in which cases animation is necessary and worked on different scenarios how can changes over time be added into the model. Several methodical suggestions were made how it can be achieved.

Form usability aspect I was introduced to new available technology at the ITC usability laboratory and the methodological approaches that can be used to evaluate the effectiveness (legibility and understanding) of visualizations. I learned what is important when conducting a usability research, what kind of technology to use, which methods of analysis are suitable for certain tasks and how to prepare for usability testing. I also learned about different approaches and software and was able to participate as a test person in one user research test.

Another result was a completely restructured development process. Based on the discussions we had on usability matters I decided to restructure the model development process according to the user centre design (UCD). The main advantage of this approach is that it places the user in the middle of the development process. Therefore, user expectations and possible arising problems are continuously under evaluation and essential changes are more easily adaptable. Throughout the development process we are now consulting with our user group. This means focusing on user group needs while selecting additional datasets for the model, designing graphical variables and adding interactive elements. Consequently, this could result as better associated and understood representations of human movement data.

Ideas for further work, collaboration perspectives

As a result of this mission we (together with my host at ITC and my supervisor from University of Tartu) started working on an article about using chorems as an alternative visualization method for human movement process. In that perspective we want to evaluate the wider applicability of chorems. We intend to use this method on different case studies. In the first case study we are planning to use chorems as the outcome of our development to distinguish an alternative regionalization for Estonian municipality system. The idea is to visualize the range of catchment areas obtained by dynamic mobile phone location data that reflect active commuting relative to existing (static) administrative areas.

Another collaboration area is related to the usability part of my research. On that part I hope to revisit ITC usability lab to carry out the evaluation tests and collaborate with Dr. Corné van Elzakker about analyzing the results.

In conclusion

The visit to the ITC had a positive impact on my research. Meetings with leading researches in the field of visualization and fellow PhD students gave me valuable feedback how to proceed with my visualization method development. Working with literature at the ITC library allowed me to get valuable information about recent achievements in the field of data visualization, animation and history of chorems. During the period I made several adjustments in my research structure and gained valuable methodological ideas how to improve the visualization method.