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USING TIME CARTOGRAMS TO EXPLORE TEMPORAL DATA: DO THEY WORK?

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Future work

Results

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GEOGRAPHICAL DATA



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TEMPORAL DATA





Free Movement



Movement along a fixed network

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PROBLEM

- Difficult to get insight into these data
- Interactive visual analytical representations need to be designed in order to
 - Analyze and synthesize these data
 - Produce useful insights about phenomena and systems associated with these data



EXISTING SOLUTIONS (1)

- Single map approaches
 - space-time cubes





EXISTING SOLUTIONS (2)

- Series of maps
 - Flow maps
- Animations





ISSUES WITH EXITING SOLUTIONS

- Limited in scope
- Memory overload issues
 - e.g. Animations
- Visual clutter problems
 - e.g. Space-time cubes and flow maps

Expensive in terms of visual space

e.g. Flow maps



TIME CARTOGRAMS

Map transformation

- Geographic distance \leftarrow time distance
- Geography/space is distorted accordingly



TYPES OF TIME CARTOGRAMS

Network based

- Some work has been done on network based time cartograms
 - e.g. Bies and van Kreveld, 2012; Ramaer, 2011; Chen, 2011; Kaiser et al., 2010; Shimizu and Inoue, 2009

Free

- Little or no work has been reported on time cartograms for free movement
 - More exciting and difficult



EXAMPLE OF NETWORK BASED (1)



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EXAMPLE OF NETWORK BASED (2)



USABILITY SURVEY



GEOGRAPHIC vs. SCHEMATIC vs. CARTOGRAM



- Effectiveness Efficiency
- Satisfaction



SURVEY EXECUTION

- 8 temporal questions/tasks
- Tasks were mainly realistic and were related to characteristics like identify, locate, and compare in time
- Randomized algorithm was used to select maps
- Test persons answer first 4 questions using the first map (selected randomly)
- And next 4 questions using second map (also selected randomly)
- Complexity of the tasks was even for each type of map
- Finally they give a rank to each map independently ranging from "Very Poor" to "Very Good"
- Created and maintained using LimeSurvey



TEMPORAL TASKS (1)

Locate

Mr. Smith is in Eindhoven to attend a 3-days workshop at the Eindhoven University of Technology. On one of the workshop days he wants to visit another city that is close to Eindhoven.

Could you please list all cities to Mr. Smith that are reachable by train within 60 minutes from Eindhoven?



TEMPORAL TASKS (2)

Compare

 Mr. Malik has only 3 days left in the Netherlands and wants to visit the Burgers Zoo in Arnhem, the Railway Museum in Utrecht, or the St. Pietersberg Caves in Maastricht.

He plans to visit a place which is the nearest to Eindhoven out of these three.

Could you please tell Mr. Malik the nearest place?

- Arnhem
- Utrecht
- Maastricht



TEMPORAL TASKS (3)

Identify

- Which pair of stations is closer (in time) to each other?
 - (Eindhoven, Oss)
 - (Eindhoven, Roermond)
 - (Eindhoven, Breda)



TEST PERSONS

- 35 test persons from 21 different nationalities
- MSc and PhD students, GIP's staff members
- Frequent users of maps
- Make use of the Dutch trains
- Little or no knowledge about the geography of the Netherlands









EFFECTIVENSS







EFFICIENCY







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CONCLUSION & FUTURE WORK

- Cartograms
 - Effective
 - Efficient
 - Perform better than the other two maps concerning the temporal aspects
- Create cartograms for free movement data
- Test their usability

