# Bridging the Gap between LBS, GeoVisualisation, and Decision Support

Gennady & Natalia Andrienko
Fraunhofer Institute AIS
Sankt Augustin, Germany



## Modern trends in geovisualisation

- Maps are used for data analysis, problem solving, and decision making

Instruments:

- ✓ Interactive & dynamic maps
- ✓ Simultaneous consideration of multiple linked displays
- ✓ Combination of visualization with computational methods (multiple-criteria decision making, data mining, statistics)

# Example 1

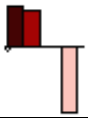
- Analysis of spatial time series (US crime)

1. Animated map
2. Data transformation => {Animated} change map
3. Time diagrams



# Example 2

- Spatial multi-criteria decision making

| | Option A | Option B |
|---|---|---|
| Initial appearance of the symbols (no comparison) |  |  |
| Comparison to option A |  |  |
| Comparison to option B |  |  |

# Example 2

- Spatial multi-criteria decision making

1. Diagrams
2. Interactive computations
3. Dynamic query with immediate visual feedback
4. Visualization that facilitates comparison of options



# LBS & Telecartography

- *Slow CPU*
- *Small amount of RAM*
- *Small screen size, low resolution*
- *Limited interaction possibilities*
- *Low bandwidth*

Technology is rapidly developing, so these problems will be solved soon

## Mobile services are widely used

- Navigation information
- Calculating optimal route
- Overview of closer surrounding
- Information about specific objects
- Field data collection (verification, update)
- On-line information access

Decision support?



## Why only Location-BS ?

- Information about a history of positions and actions of the person can be used for making the mobile services more focused and useful:
  - Current time
  - Speed and duration of the movement
  - Moments and locations of stops
  - Usual preferences and behaviour of the user
  - …

## Scenario: **informed** decision making

- Typical task: find a suitable hotel
- General procedure:
  1. Specify preferences and constraints
  2. Request a list of suitable options from server
  3. Select some {best} options for detailed study (request additional information, display map, proceed with booking a room, calculate route etc.)



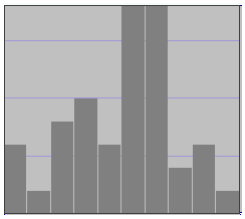
## Problems

1. What price is reasonable for a hotel room in Vienna in January? … Statistics
2. What hotels are close or well connected by public transport to TU Vienna? … Geocomputations
3. Strict query => no options to select from; relaxed query => hundreds of options … Dynamic query
4. Multiple conflicting criteria! … MCDM, sensitivity analysis, tolerance

# More flexible procedure - 1

1. Request statistics of distribution of values of the decision criteria from server

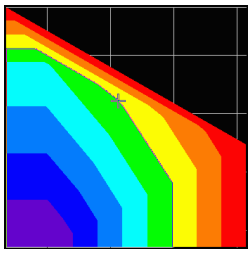
2. Study distribution of values for deciding about feasible values of individual criteria





# More flexible procedure - 2

3. Analyse trade-offs between the criteria

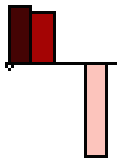


4. Formulate a query, request results. Tolerance!

## More flexible procedure - 3

5. Specify a feasible goal (values of multiple criteria)

6. Find options close to the goal and analyze them using maps and other visualizations





## Discussion

- We adapted the highly interactive and dynamic method so that it can be implemented in a mobile environment:
  - Small amounts of client-server communication
  - Modest requirements to CPU, RAM, screen size
  - Limited interaction
- Similar adaptations could be done for other methods

# Conclusions

- Modern geovisualization creates new exciting opportunities for mobile users
  - Context- & Task-based dynamic displays
  - Decision support
- New research questions:
  - What are possible tasks and scenarios?
  - How existing methods can be adapted for mobile usage?
  - What methods are missing?
  - How uses can be educated?