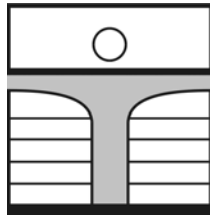# Using geographic tracking data to analyse spatial behaviour in eTourism

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Outline

- Motivation
- Related Work
- Design of Field Study
- Methodologies/Results
  - Spatial Maps
  - Spatial Distribution
  - Activity Discovery by position
  - Discovery by walking speed analysis
  - Flows of Areas of Interest
- Future research

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Why is the spatial behaviour of tourists important?

- No quantitative data about the positions of tourists! (just the number of overnight stayings)

- Restaurant success depends on the exposure to tourists

- Real estate agents use spatial behavior to assess value of real estate

- Success of marketing campaigns by restaurants or DMOs become measurable

- City administration / Destination Management Organization (DMO) need to avoid overcrowding of single places

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Related Work

- Freytag: study in Heidelberg ➔ spatial behavior of tourists is very concentrated

- Kempermann: tracking of visitors behavior in a theme park ➔ significant difference between first-time and repeated visits

  ➔ Rely on diary data or questionnaires

- Dijkstra: Simulation of the movements of pedestrians by agents

- Shoval, Isaacson: comparison of different tracking systems (GPS, land-based tracking)

- Larson, Bradlow, Fader: Analysis of the paths of shopping carts in a supermarket with RFID Tags
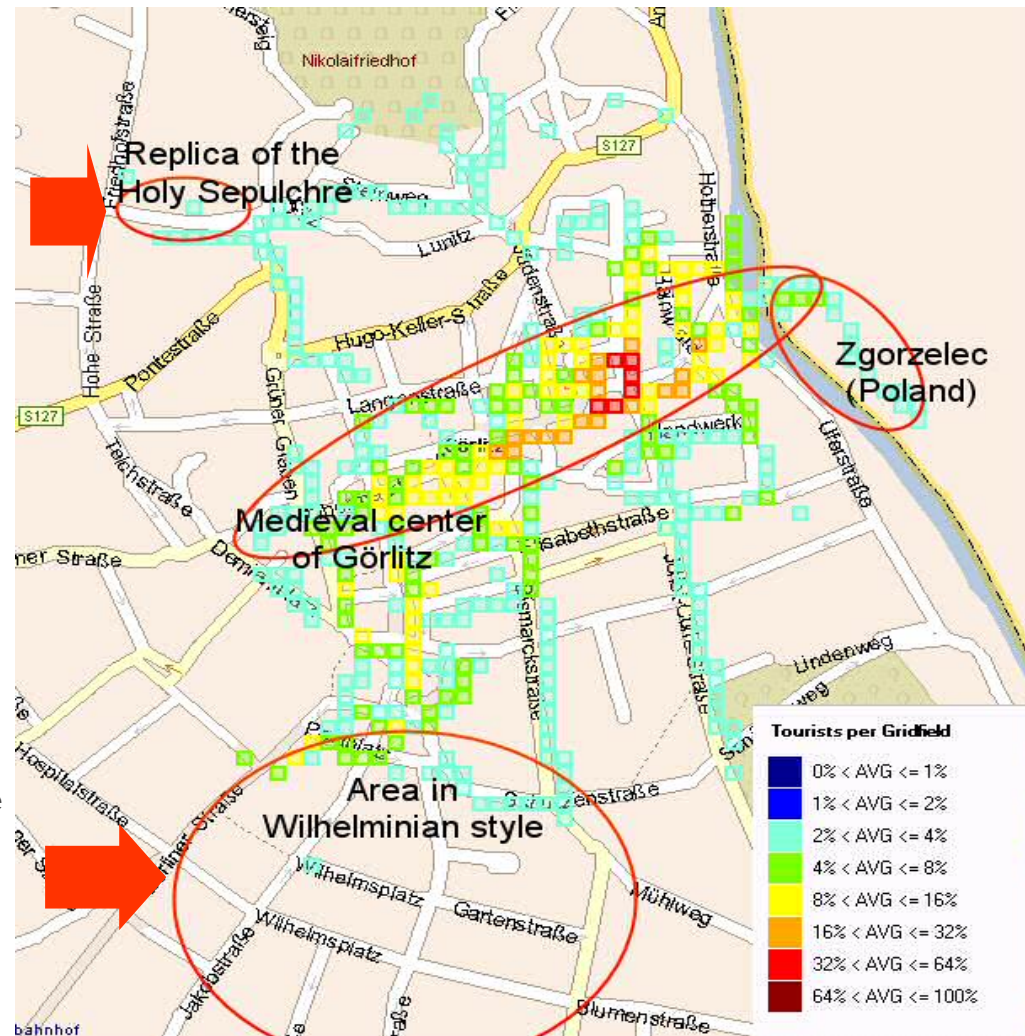
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Experiment

- 4 weeks from 01.June To 30.June
- Stand at the Untermarkt in Görlitz

- Distribution of MDA and GPS mouse to tourists as part of field trial of a Restaurant Assistant
- MDA and GPS communicate via bluetooth
- Log w/ position and time

- Download log to PC after return of the MDA / GPS combo
- Analysis

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Spatial Density Map

- Overlay map with grid
- Increment grid counter if a tourist visits a grid cell
- Color coding to visualize the counter
  - Dark red = often visited
  - Dark blue= visited by a few

- Visualization of untapped potentials in the tourist destination Görlitz
  - Replica of the Holy Sepulchre
  - Large quarter in consistent Wilhelmian style

- Görlitz (D) / Zgorzelec (PL) is one destination for many visitors

Tourists per Gridfield

	0% < AVG <= 1%
	1% < AVG <= 2%
	2% < AVG <= 4%
	4% < AVG <= 8%
	8% < AVG <= 16%
	16% < AVG <= 32%
	32% < AVG <= 64%
	64% < AVG <= 100%

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Spatial Distribution - Relative Spatial Distribution Metric

Relative Number of Visits

$$RNoV(i,j) = \frac{NoV(i,j)}{TNoV}$$

Spatial Distribution Metric

$$SDM = -\sum_{\forall i,j} RNoV(i,j)\log_2(RNoV(i,j))$$

Relative Spatial Distribution Metric

$$RSDM = \frac{SDM}{\log_2(I \cdot J)}$$

NoV(i,j)		RSDM	NoV(i,j)		RSDM	NoV(i,j)		RSDM
10	10	1	10	0	0	10	1	0.22
10	10		0	0		0	0	
10	1	0.41	10	5	0.75	10	5	0.9
1	0		5	0		5	2	
10	7	0.96	10	7	0.98	10	8	0.99
5	4		6	5		8	7	

➜ RSDM(Görlitz) = 0.6

Analysis of Activities using Hot-Areas

- Virtual georeferenced activity area
- Areas are associated with activity categorization (Restaurant, Museum etc.)

- ➔ Special evaluation of sights
- ➔ Analysis of the tourists behaviour in the whole area
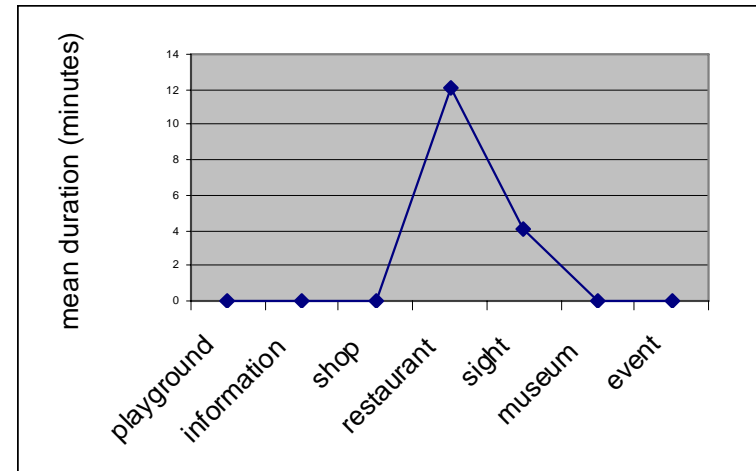
➔ Confirms Schmidt-Belz: „A restaurant is the most important information need"

- Example: „Vierradenmühle" (Restaurant by a waterfall)
  - Mean tourists stay: 2.3 min ➔ Mainly „lookers" ...
  - The waterfall attracts many tourists, few become guests in the restaurant
  - ➔ Marketing opportunity

Challenge: GPS accuracy

Automatic discovery of activity areas: Walking speed

- Hot-Area approach depends on GPS accuracy
- More robust method is needed
- ➔ automatic discovery by filtering the walking speed

- Walking speed distribution is bi-modal
  - Slow down ➔ activity found
  - Walking between activities
- Individual threshold for each tourist
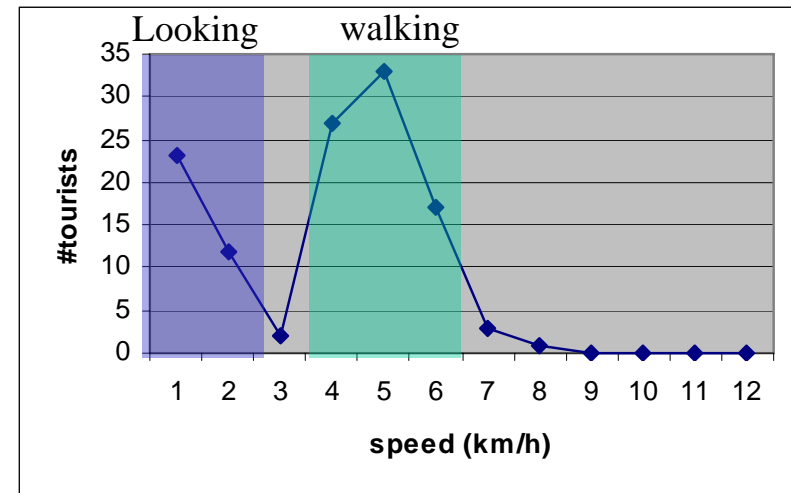
- Many tourists stop at many places ➔ Many areas with slow-downs
- k-means clustering to identify centroids

Clustered Slow-Down Area (SDA) ➔ Activity

1. Filtering of the walking speed of each tourist to identify the individual slow-down areas (SDA) and the distribution of durations.

2. Cluster the slow-down areas of all tourists

3. Compute duration distributions for the "clustered slow-down area".

4. Visualization:
   1. Compute a center for each SDA
   2. Draw a circle with the number of tourists indicated by the colour/shade and the average duration by the size.

➔ The deeper the blue, the more tourists attended the attraction

➔ The greater the circle, the longer the tourists stayed there

Untermarkt

Obermarkt

Via Regia

Postplatz
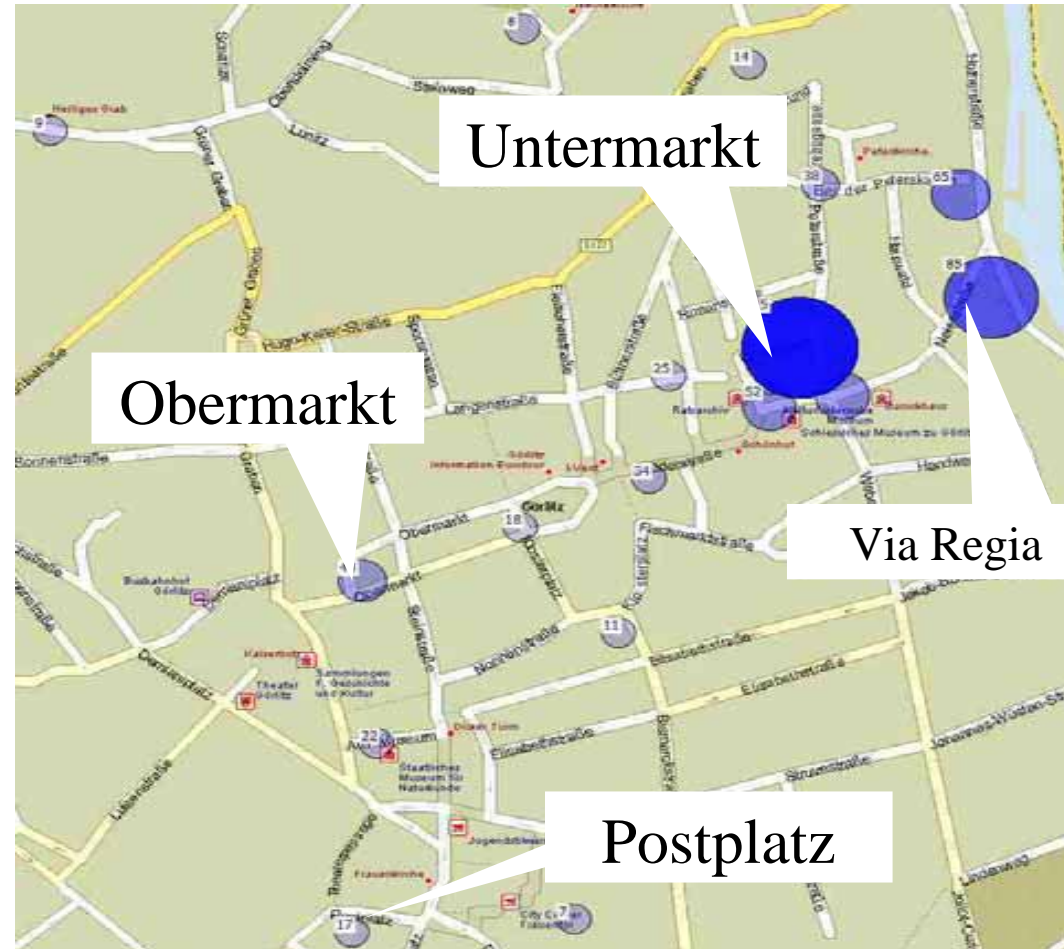
Flows between AoIs
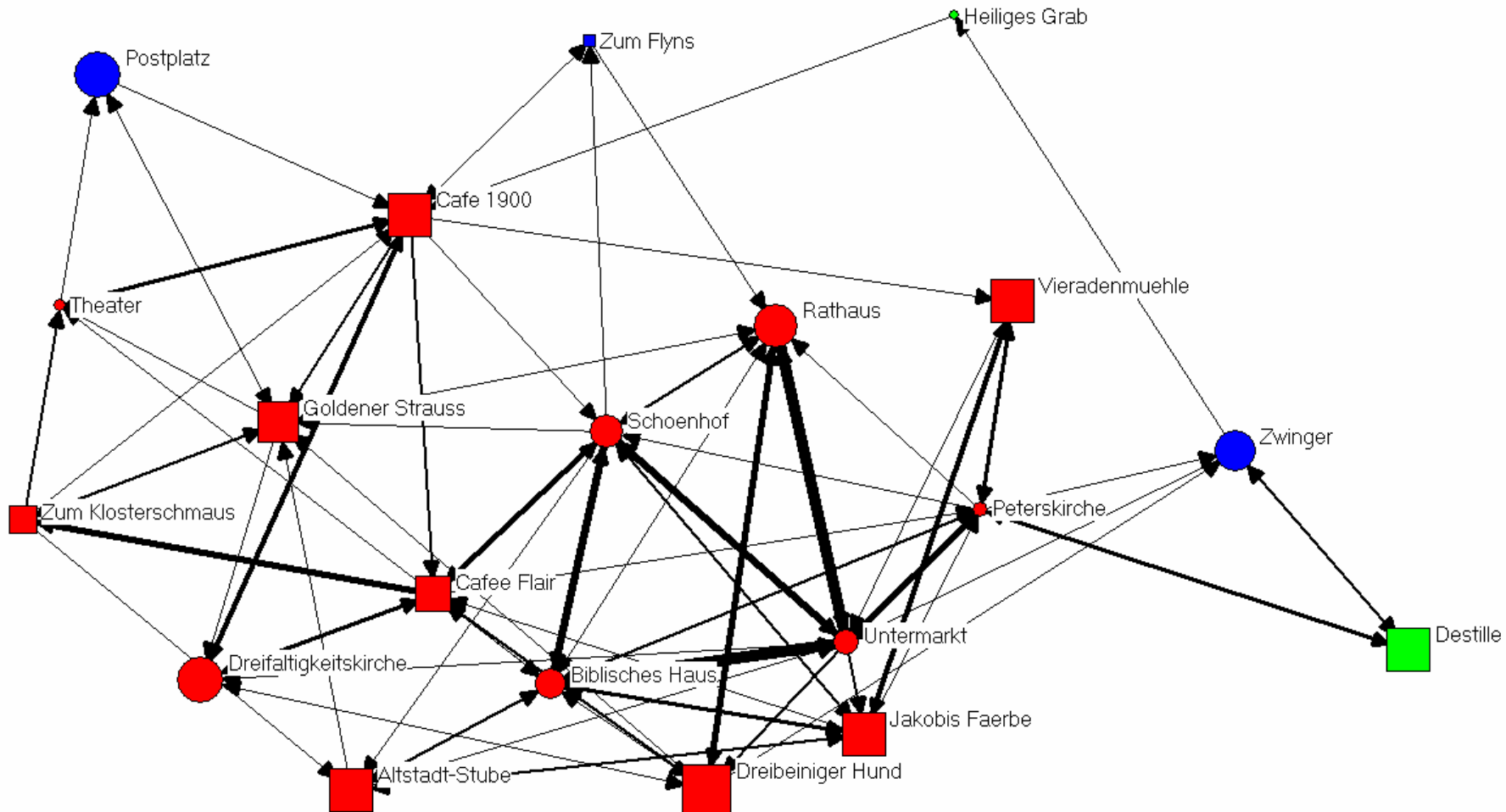
Future research

- Clustering without background information leads sometimes to a misinterpretation (stop to chat with a friend == sightseeing??)

- Combination of MDA and Bluetooth GPS receiver is error prone ➔ use stand alone GPS loggers!!

- Capturing the spatial behavior was a by-product of the field trial for the Dynamic Restaurant Assistant. ➔ Independent study using GPS loggers.

- Spread hand-out place over the destination

- City councils recognized the importance of the study ➔ another field trial in summer of '06

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Conclusion

- Methodology for analyzing the spatial behaviour quantitatively
  - Identify the state of a destination with SDM
  - Find potentials with spatial maps
  - Analyze interest-fields with the hot area approach
  - Find (tourists) interesting places automatically

- Delivers an important base and feedback for the marketing of restaurants, DMOs or city administrations, marketing firms and real estate agents

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Thanks for the attention
☺

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appendix

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Field Study in Görlitz

- Summer 2005: 15 MDA's equipped with Bluetooth GPS receivers

- Stand on the Untermarkt

- Ask „real" tourists to carry the devices during their tour

- Questionnaire data about their computer literacy and whether this is the first visit to Görlitz

- Tracking and collecting the spatial data

- Subsequent analysis

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