Safest Path for Bicyclists
How to model secure Routes in Urban Areas

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Why bicycle safety?
How can GIS support the promotion of safe cycling?
What makes a bicycle route safe?
Assessment model and safety index
Application: Find a Safe Route
“Road safety: Second good year in a row puts Europe firmly on track towards target” (EC - IP/14/341; 31/03/2014)

Another worrying feature of the statistics is the situation of vulnerable road users: The number of pedestrians killed is decreasing to a lesser extent than expected and the number of cyclists killed has recently even been increasing. This is partly due to the fact that more and more people cycle; the challenge for Member States is to encourage people to use their bicycles rather than their cars more often, but to make sure that the shift from car to bicycle is a safe one.
How can GIS support the promotion of safe cycling?
Goal

Assessment of Network

- Status-quo analysis
  - Weak-point analysis
  - Corridors
  - etc.

- Planning & Infrastructure
  - Priority of measures
  - Budget allocation
  - etc.

- Information
  - Routing
  - etc.
Workflow

Stage 1: Analysis
- Spatio-temporal analysis of accident data set
- Specification of accident types/categories
- Formulation of recommendations

Stage 2: Model
- Development of an indicator-based model for road network assessment
- Focus on road safety for bicyclists

Stage 3: Application
- Development routing system
- Application for planning and simulation tasks
Indicator-based approach
What makes a bicycle route safe?

- Road safety for bicyclists
- Indicators (examples):
  - Bicycle infrastructure
  - Road category
  - Traffic volume
  - Max speed
  - Road surface
- Weights:
  - Empirical studies (field tests)
  - Accident analysis
  - Expert knowledge
Indicator-based GIS Model

- Transparent
- Reproducible
- Scalable
- Comparable
- Globally applicable
- Transferable
Model Workflow

Assessment Model

- Bicycle infrastructure
- Infrastructure type
- Tagged bicycle route
- Traffic load
- Maximum speed
- Road surface
- Category
- Infrastructure
- Speed
- Traffic load
- Access
- Restriction
- Tracktype
- Surface

Modelling with standardized result

Weights assignment for resp. environments

Indicator definition on a meta-level

Data sets with different data models

OSM
Admin. data
Case Study
Study Area & Data

- Authoritative data for city of Salzburg
  - 11,458 edges
  - 1,119.7 km net length

- OpenstreetMap extract for adjacent municipalities
  - 9,601 edges
  - 941.3 km net length

- Data sets with different data model and attribute structure
Problem Statement

- Different data sets from different sources
- Different data models
  - Geometry and attributes
  - 
    - type = road
    - bicycle_infra = cycleway
    - type = road
    - type = cycleway
- Different environments to adapt the model for
  - Urban vs. rural
### Data models

#### Authoritative graph
- Center line
- Complex attributive formulation of bicycle infrastructure
- Complete and homogeneous

<table>
<thead>
<tr>
<th>DB-Name</th>
<th>Attribute</th>
<th>Value</th>
<th>Value description</th>
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<tr>
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<td>Road category</td>
<td>400</td>
<td>Municipal road</td>
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<tr>
<td>SIC_STRAS5</td>
<td>Max.speed, km/h</td>
<td>50</td>
<td></td>
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<tr>
<td>SIC_STRA9</td>
<td>Buslane</td>
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<td>Yes, FT</td>
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<tr>
<td>SIC_STR13</td>
<td>Oneway</td>
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<td>Yes, FT</td>
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<tr>
<td>SIC_RAD_RE</td>
<td>Bicycle infrastructure (right side, FT)</td>
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<td>Yes, undefined</td>
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<tr>
<td>SIC_RAD_R1</td>
<td>Bicycle infrastructure (left side)</td>
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<td>Cycle-/footway mixed</td>
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<td>No</td>
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<tr>
<td>SIC_RAD_R5</td>
<td>Direction bicycle infrastructure (TF)</td>
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<td>Both directions, independet from oneway</td>
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<tr>
<td>SIC_STR24</td>
<td>Motorized traffic load, V/24h (TF)</td>
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<td>SIC_STR25</td>
<td>Motorized traffic load, V/24h (FT)</td>
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Data models

OSM graph

- Edge for every physically separated lane
- Very simple tag (key = value) structure
- Up-to-date
- Gaps, inconsistencies, errors, heterogeneous attribute structure

<table>
<thead>
<tr>
<th>Key</th>
<th>Value</th>
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<tbody>
<tr>
<td>highway</td>
<td>path</td>
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<tr>
<td>bicycle</td>
<td>designated</td>
</tr>
<tr>
<td>foot</td>
<td>designated</td>
</tr>
<tr>
<td>surface</td>
<td>paved</td>
</tr>
</tbody>
</table>
Geometry & Topology

β Transfer points
  – Bridges, under-/overpasses
β Transition edges
β Line matching
Result: „Safety Index“

Pedestrian- and bicycle lane (separated), no motorized traffic
Index value = 0.68

Bicycle lane, no parking
Index values = 1.12

Residential road, no bicycle infrastructure, parking on both sides
Index value = 1.56

Primary road, bicycle lane, parking for delivery purpose
Index value = 1.81
Application „Safety Route“

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