

A Hybrid Model for Indoor Spatial Reasoning

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Motivation

Mobile Geospatial Augmented Reality – for human users

- ▶ human spatial cognition and reasoning mostly qualitative
- ▶ machine models, representation, and reasoning mostly quantitative

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- ▶ necessity for both paradigms
- ▶ integrated models needed

Qualitative vs. Quantitative Methods

Examples:

- ▶ landmarks
- ▶ coordinates
- ▶ topology
- ▶ (metric) distal and angular data
- ▶ fuzziness
- ▶ (cardinal) direction
- ▶ (numeric) features

Qualitative vs. Quantitative Methods

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Qualitative vs. Quantitative Methods

Examples:

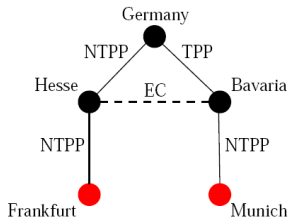
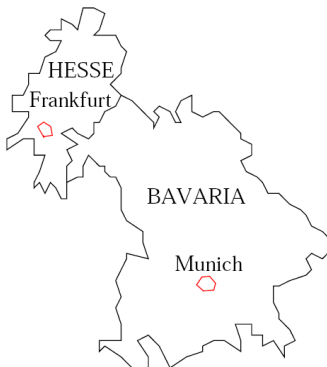
- ▶ landmarks
- ▶ **coordinates**
- ▶ topology
- ▶ **(metric) distal and angular data**
- ▶ **fuzziness**
- ▶ (cardinal) direction
- ▶ **(numeric) features**

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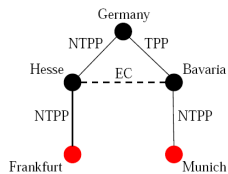
Qualitative vs. Quantitative Methods



Qualitative vs. Quantitative Methods

Reasoning based on RCC-8

1. Munich is located in Bavaria, Frankfurt is located in Hesse
2. Bavaria and Hesse share a border
3. Hesse is part of Germany
4. Bavaria is part of and shares a border with Germany
5. $1 \wedge 4 \Rightarrow$ Munich is located in Germany



Hybrid Model

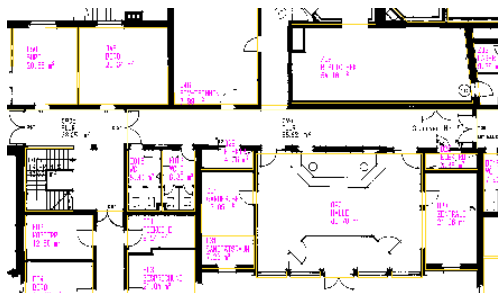
Key features

- ▶ based on a graph structure (topology) enriched with meta data
- ▶ extensible in a multimodal way
- ▶ suitable for available indoor positioning technology
- ▶ basis for efficient applications (mobile devices)
- ▶ integration of active/passive positioning data of moving entities
- ▶ enhancing possibilities for human interaction
- ▶ key scenarios: medium/large scale indoor environments, e.g.
 - ▶ hospitals
 - ▶ airports, railway stations
 - ▶ government facilities

Hybrid Model: Heterogeneous Data

Heterogeneous data

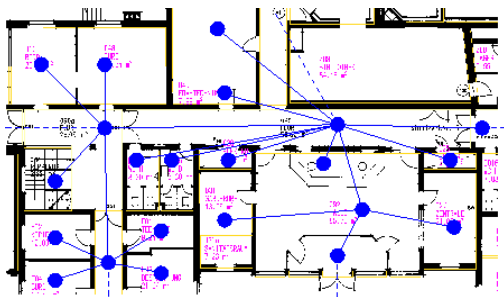
- ▶ floor plan / cadastral data
- ▶ structural data
- ▶ metadata, e.g. “room E1.05, Prof. Smith, ext. -2354”



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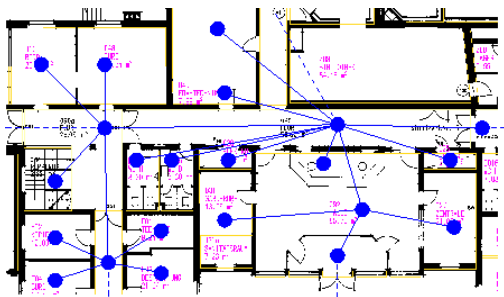
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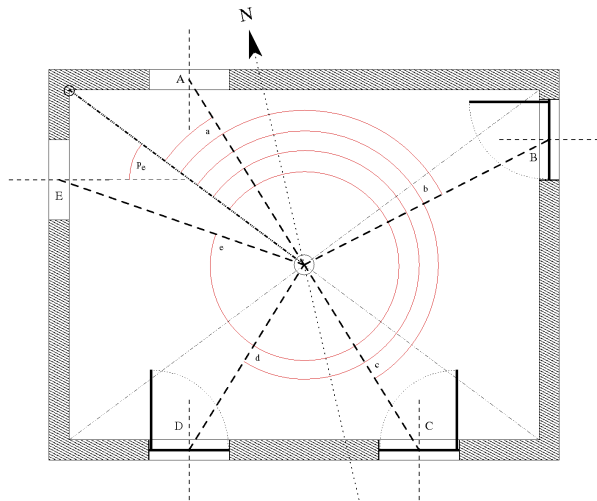
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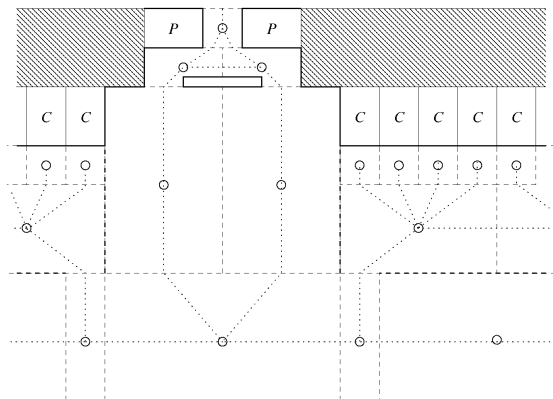
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Hybrid Model: Room Sample



Hybrid Model: Segmentation Sample



- *Hard boundary*
- - - *Soft boundary*
- · - · *Segment boundary*
- *Path*
- *Segment centre*

Outlook

Current work:

- ▶ prototypical implementation (campus data)
- ▶ single building scenario

Future work:

- ▶ multiple building scenarios
- ▶ more complex scenarios (airport, hospital)
- ▶ multimodality

Thank you for your attention.

Questions / Discussion

Further information:

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- ▶ <http://www.pms.ifi.lmu.de/mitarbeiter/~lorenz>

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