

DFG Priority Program 1021 “Spatial Cognition”



Christian Freksa

Universität Hamburg

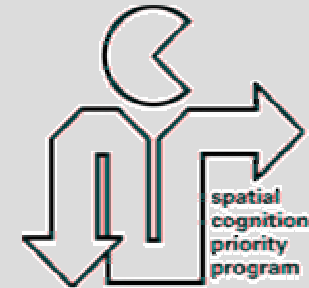
(Coordinator,

Projects “Aspect Maps”, “Spatial Inference”)

Axel Lankenau

Universität Bremen

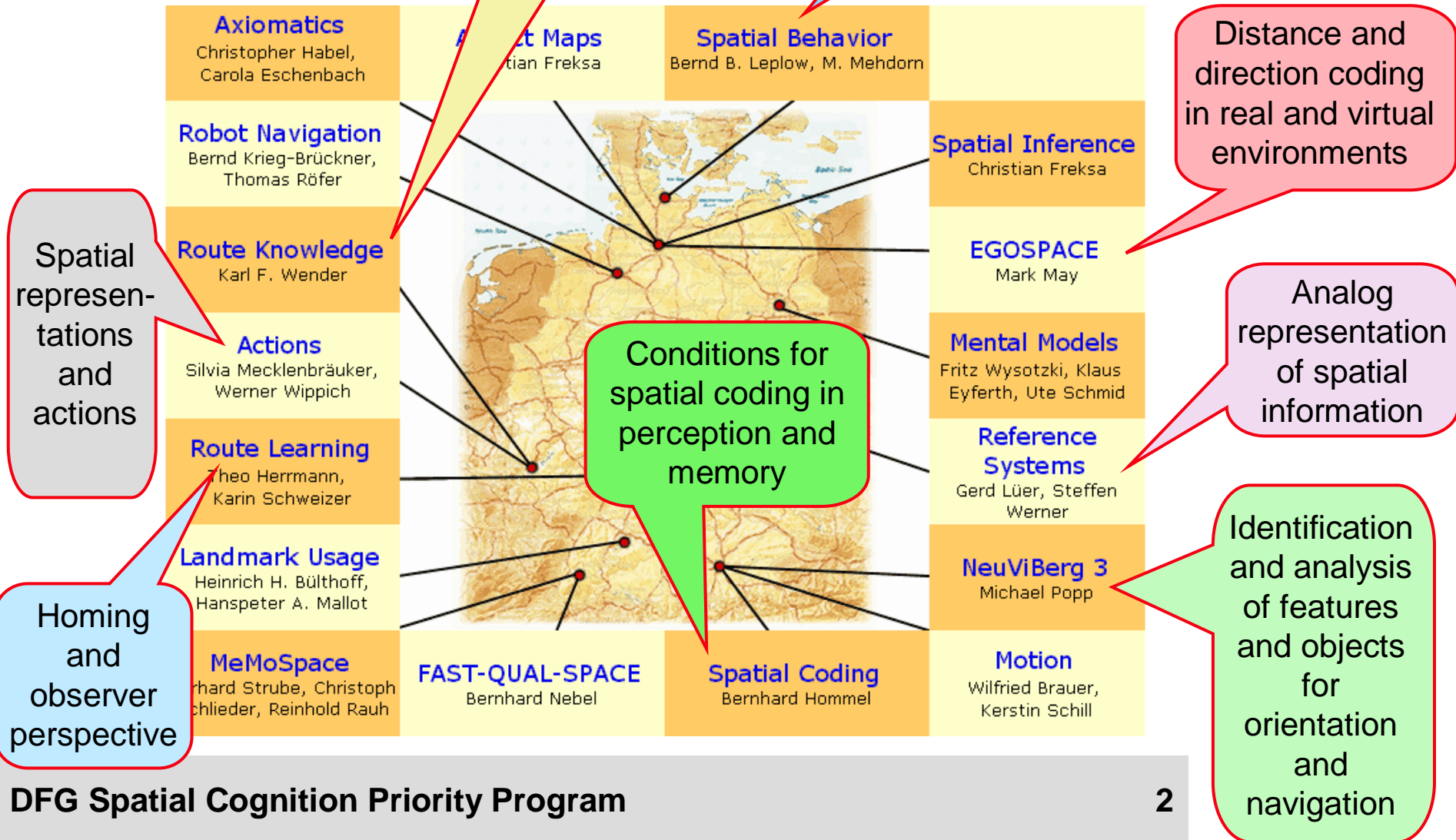
(Project “Robot Navigation”)

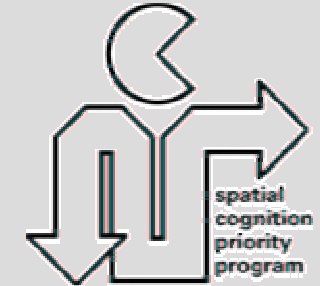


Priority Programs

Representation and activation of route knowledge

Experimental analysis of spatial behavior in humans





Priority Programs

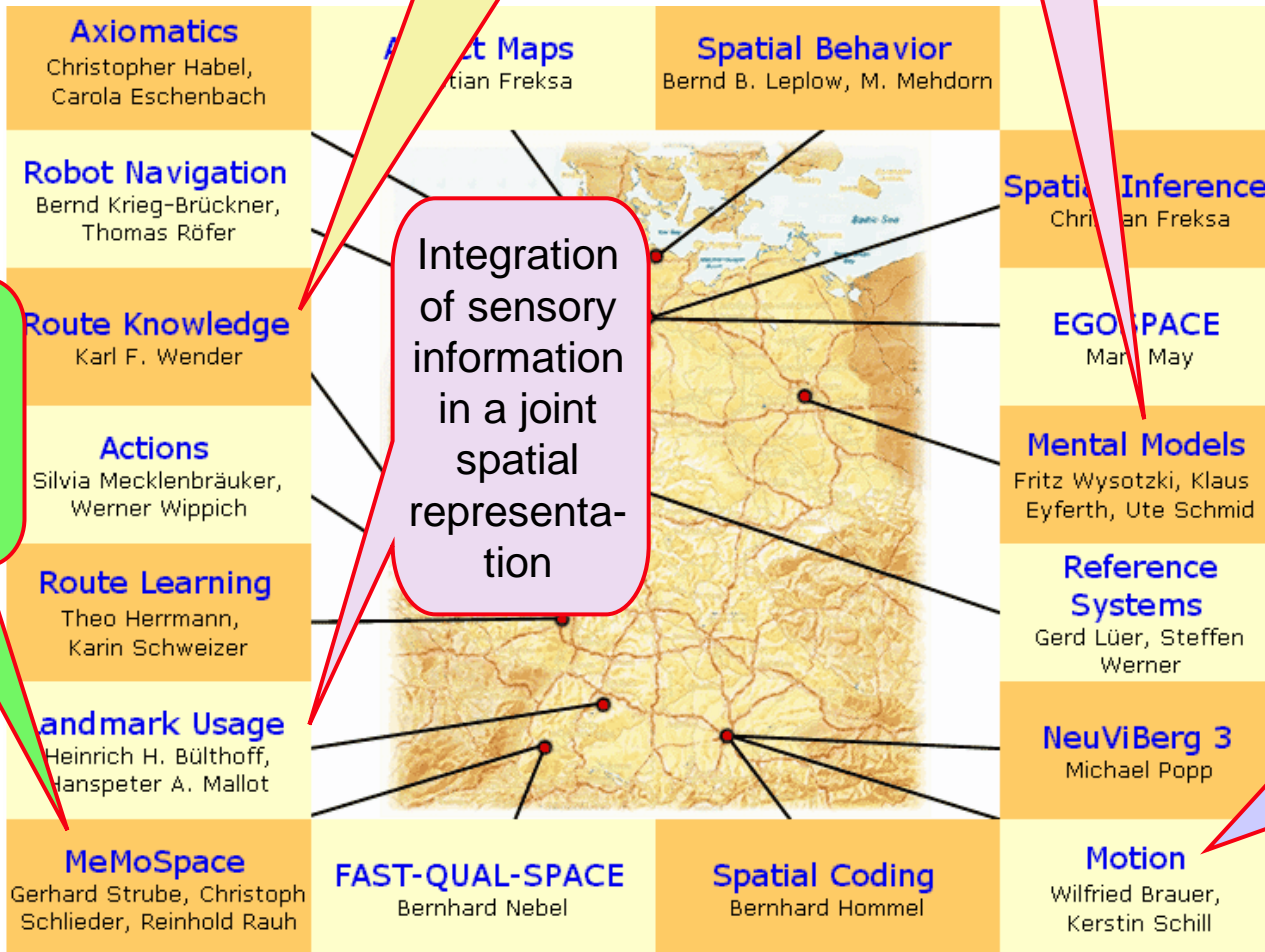
Representation and activation of route knowledge

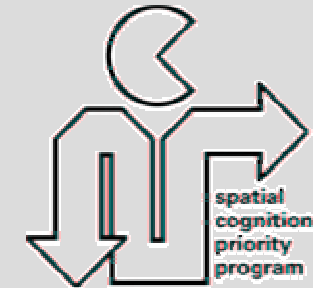
Modeling inferences in mental models

Mental models in spatial reasoning

Integration of sensory information in a joint spatial representation

Qualitative representation of the course of motion: cognitive and psychophysical foundations





Priority Program

Interpretative and constructive processes in spatially organized knowledge structures

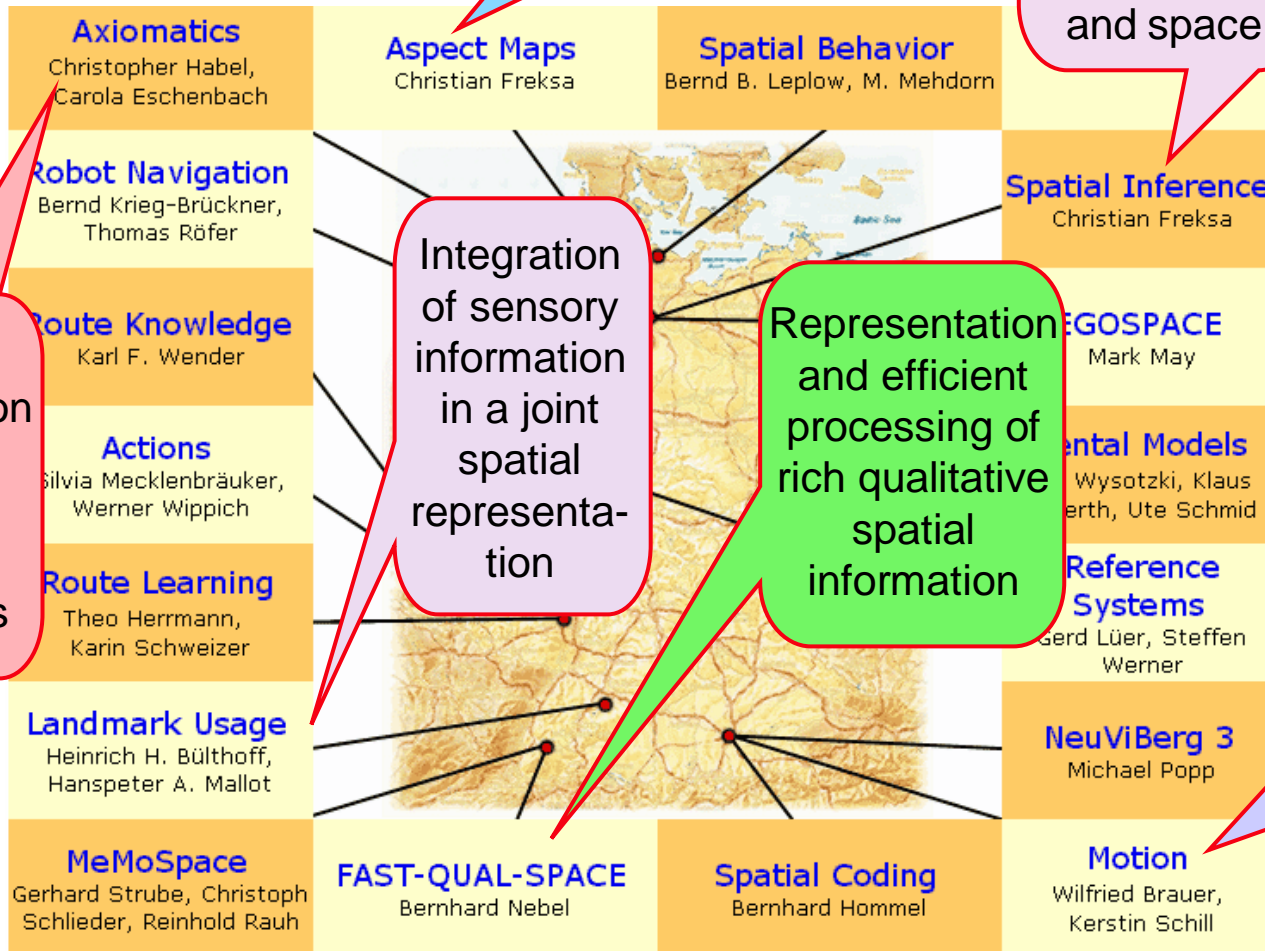
Representing and processing qualitative knowledge about time and space

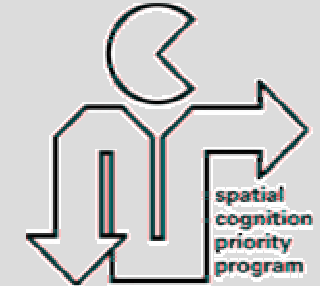
Formal specification of spatial concepts and structures

Integration of sensory information in a joint spatial representation

Representation and efficient processing of rich qualitative spatial information

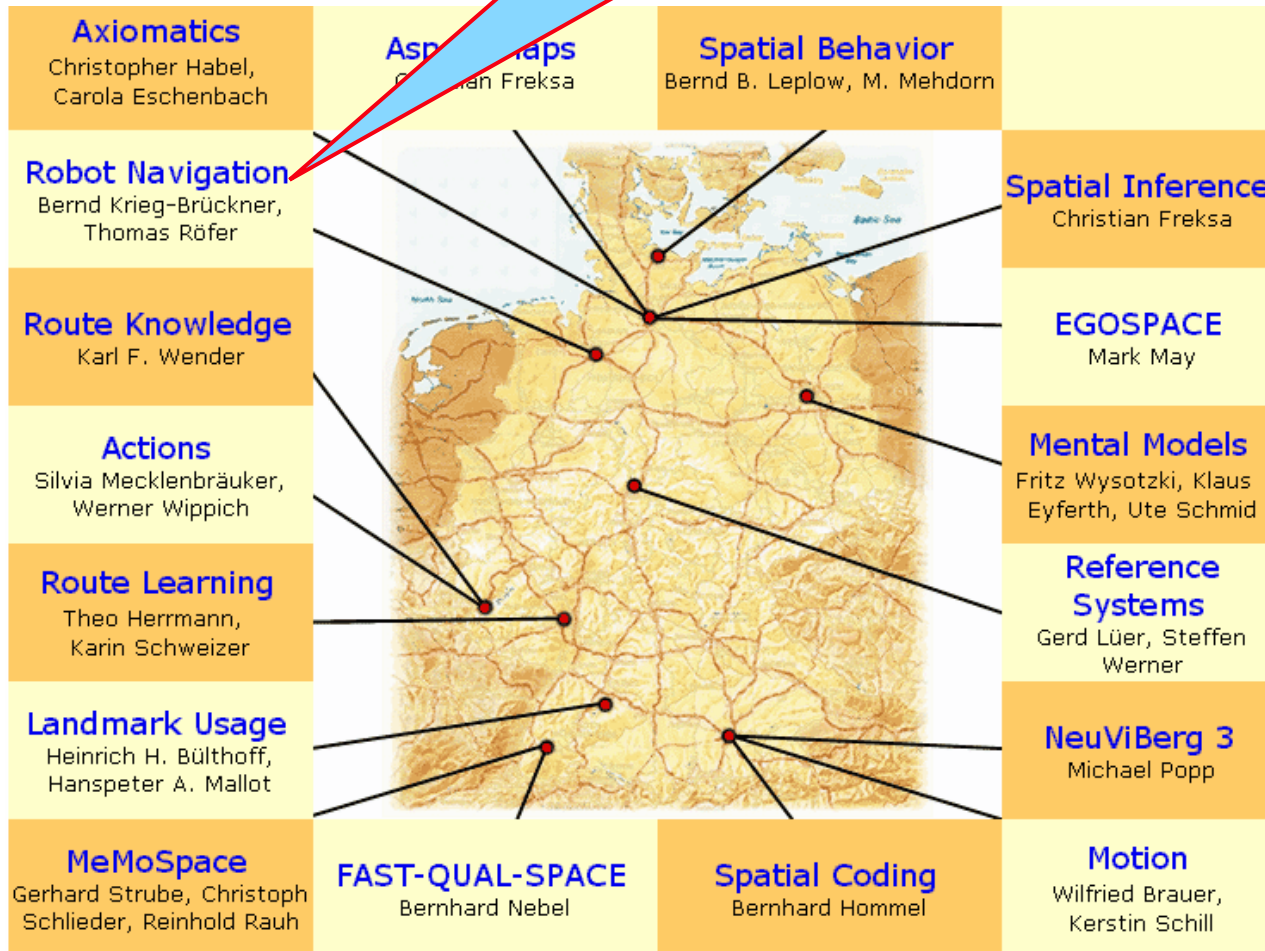
Qualitative representation of the course of motion: cognitive and psychophysical foundations





Participating Projects

Semi-local 3-D landmarks based on image sequences for navigation in dynamic environments





Navigation Assistant – Rolland

- ▶ **Self-Localization in Large-Scale Environments**
 - ▶ Modeling the current robot situation
 - ▶ Modeling the environment
 - ▶ Matching both models
- ▶ **Guiding the User**

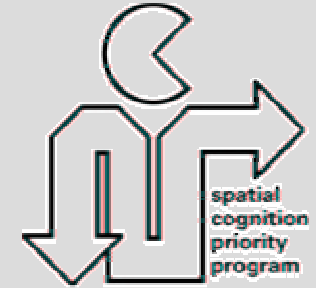


user interface

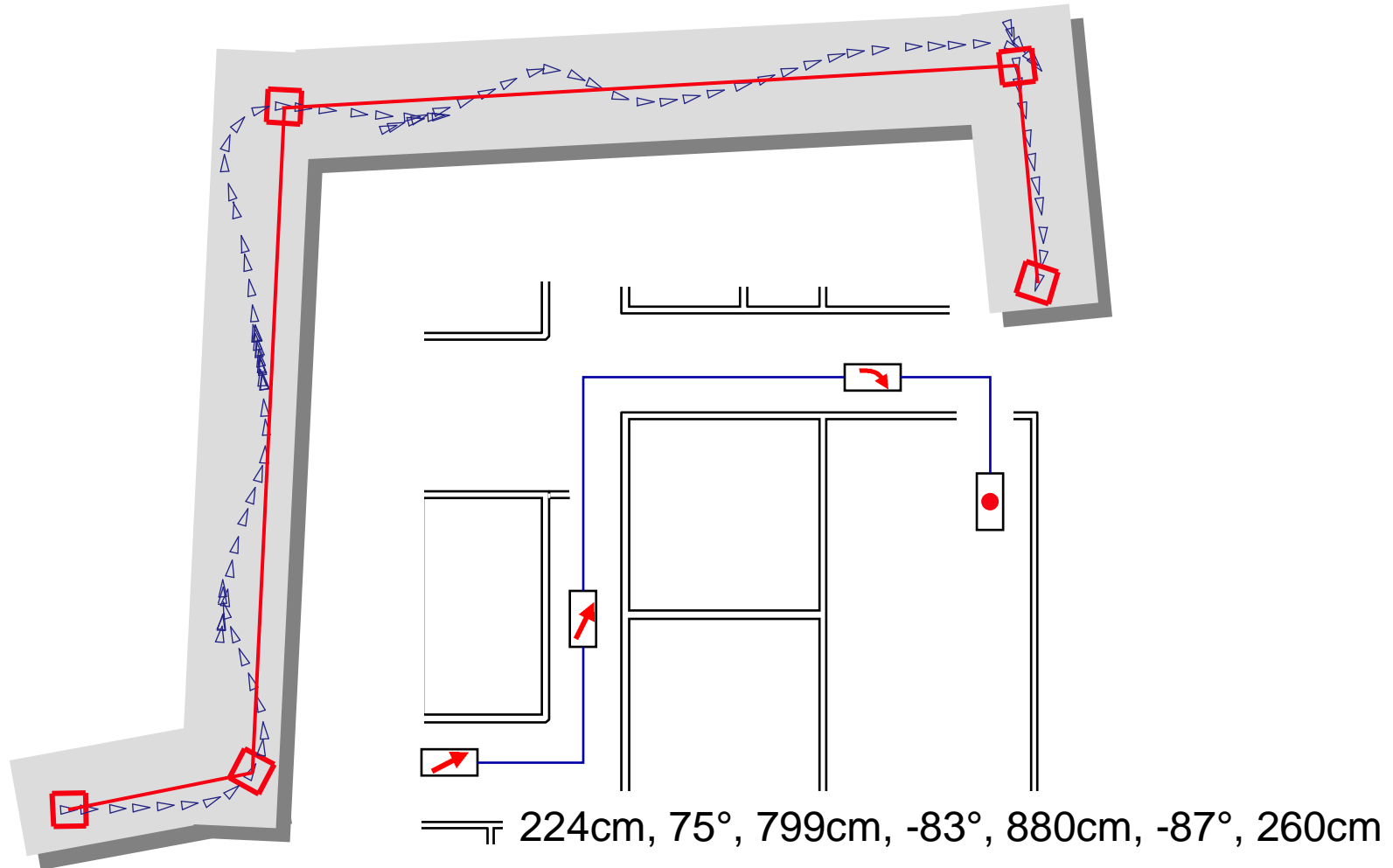


visual instructions

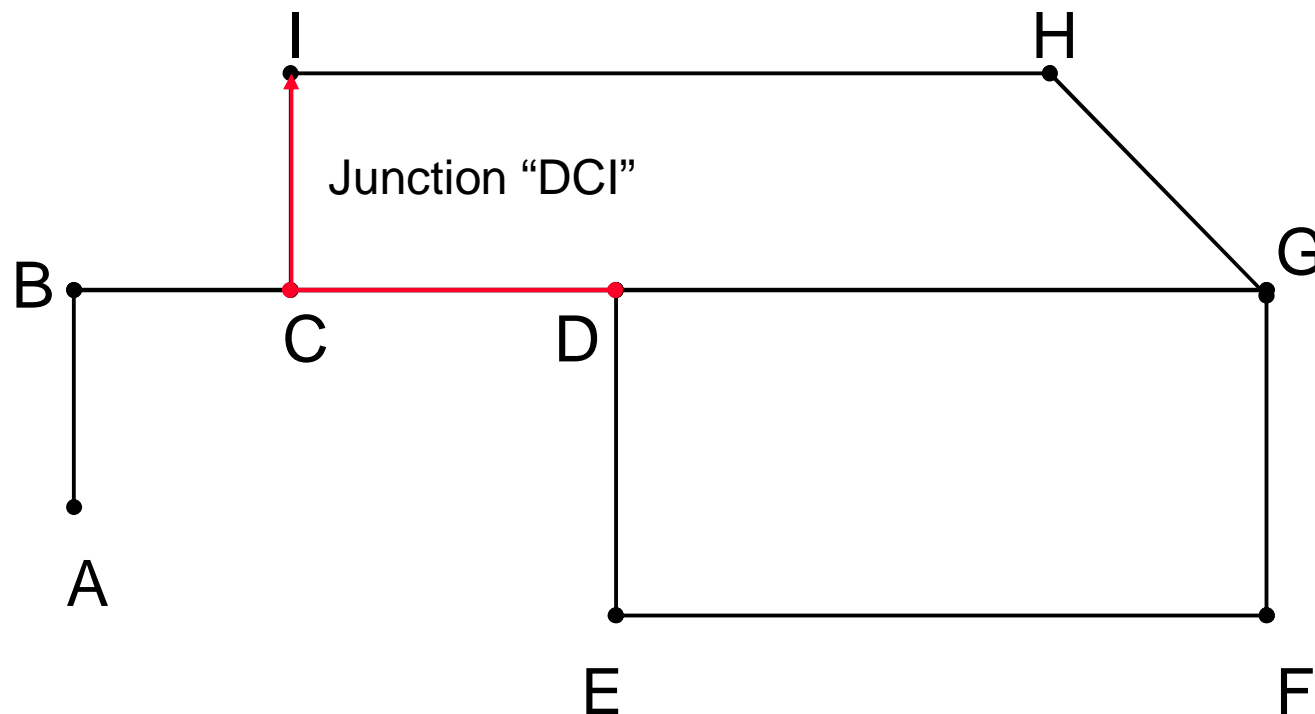




Situation Model: Route Generalization



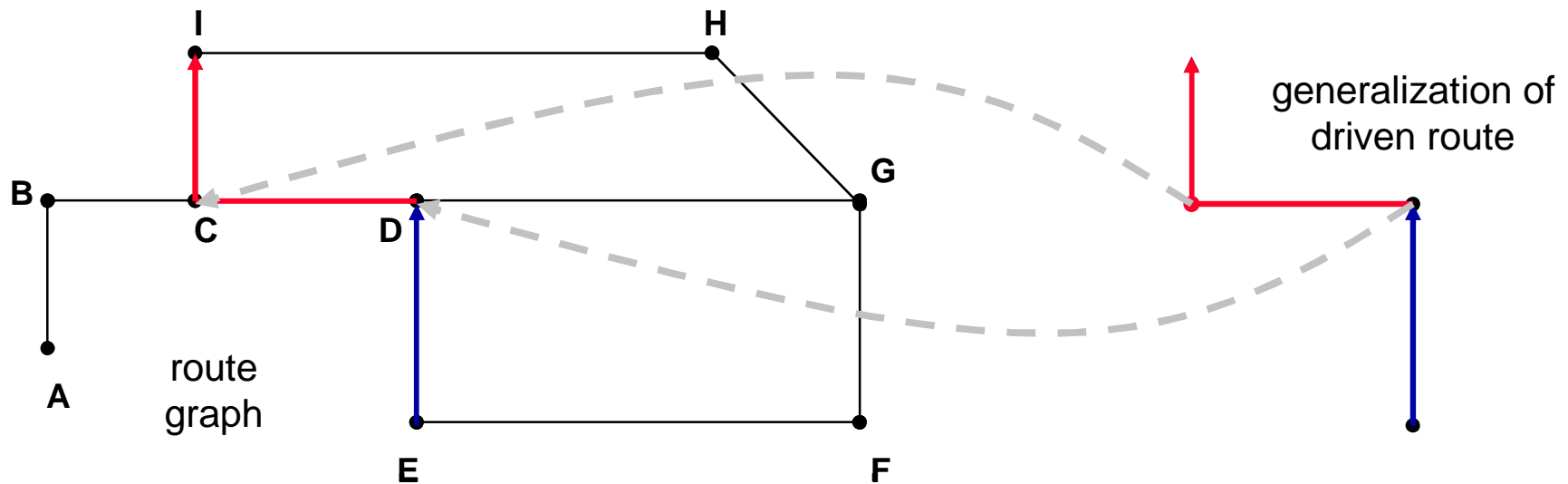
Environment Model: Route Graph

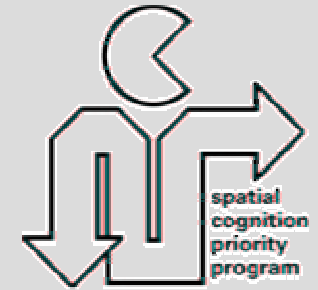




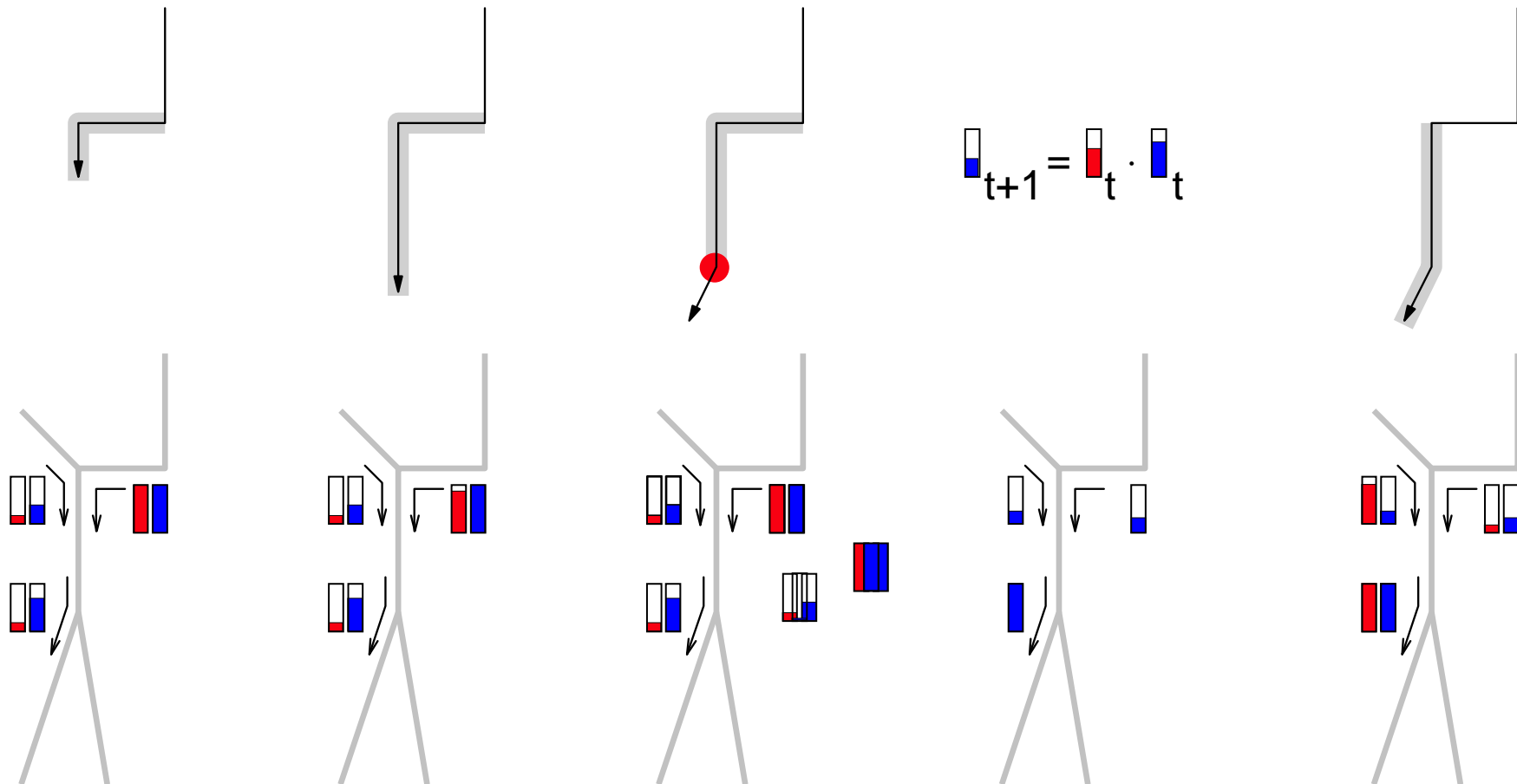
Inductive Probabilistic Approach

- ▶ **Idea: Mapping route corners to junctions**
- ▶ **Two-step mapping**
 - ▶ Corner matches a junction
 - ▶ The rest of the generalized route matches up to the junction

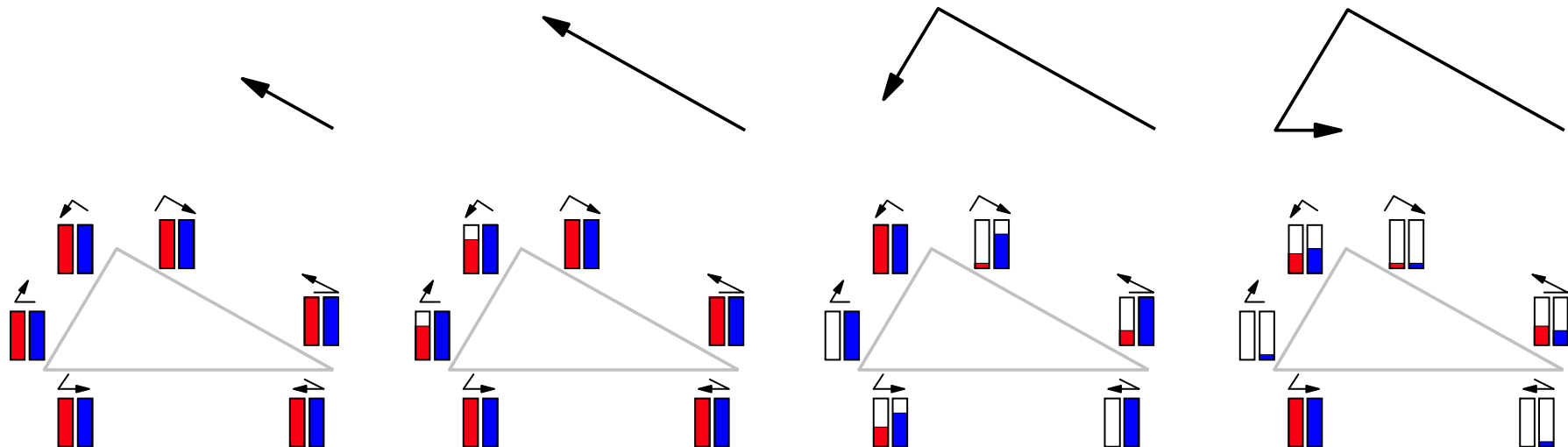




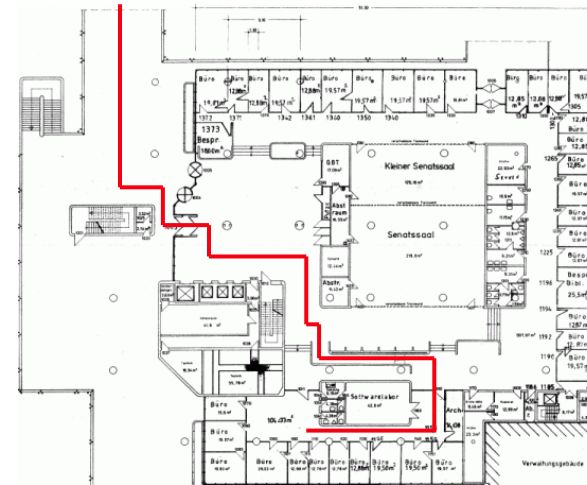
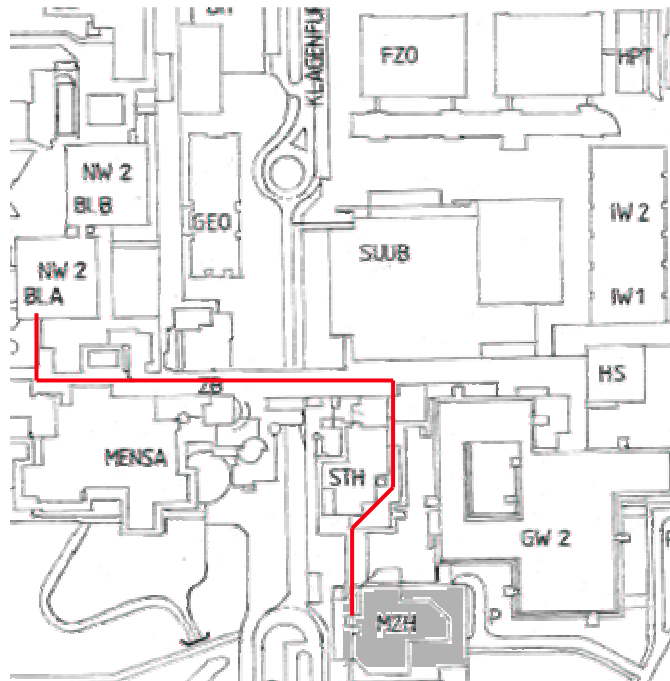
Propagation of Probabilities



Determining the Candidate Junction

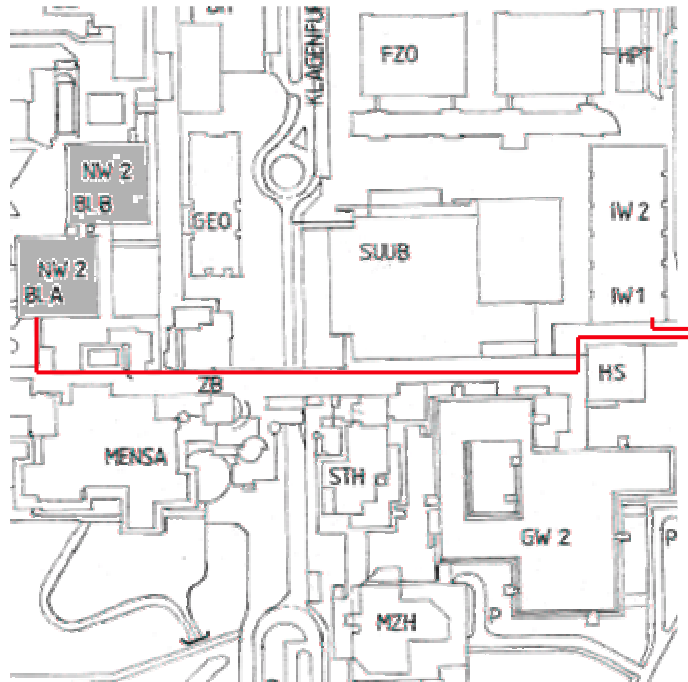


Indoor and Outdoor Navigation



- ▶ Building: MZH

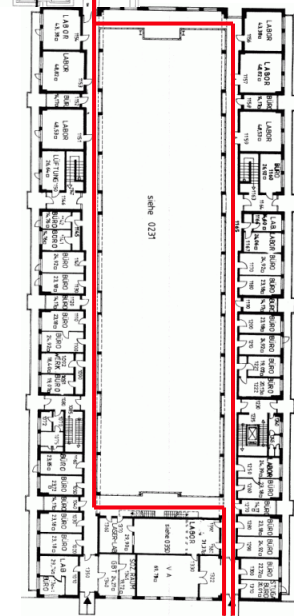
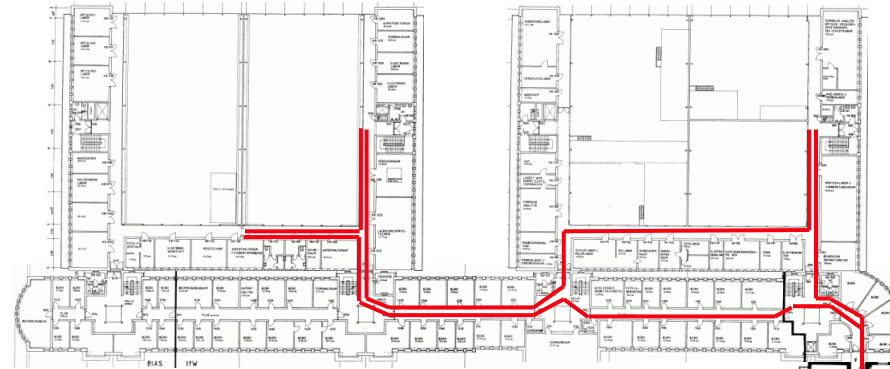
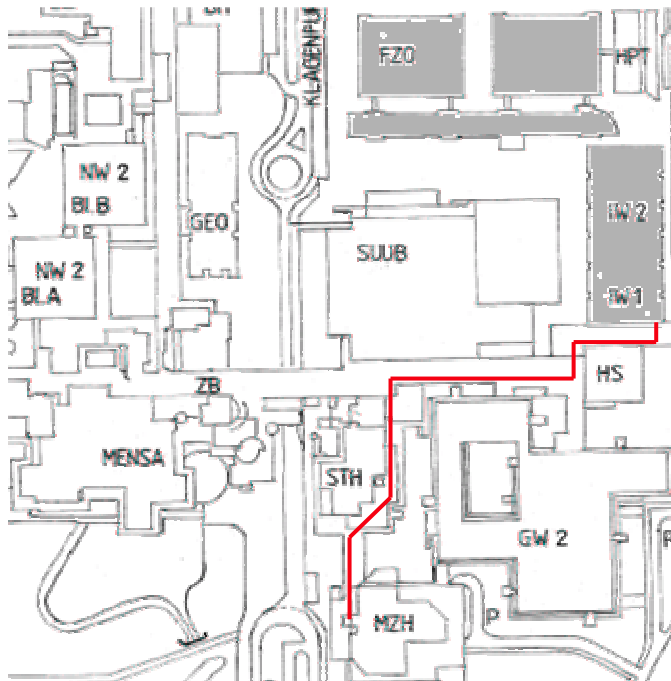
Indoor and Outdoor Navigation



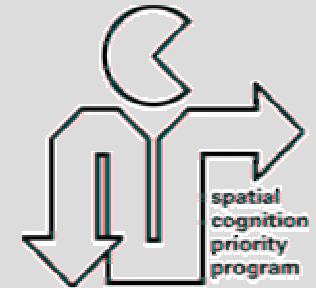
- ▶ Building: NW 2



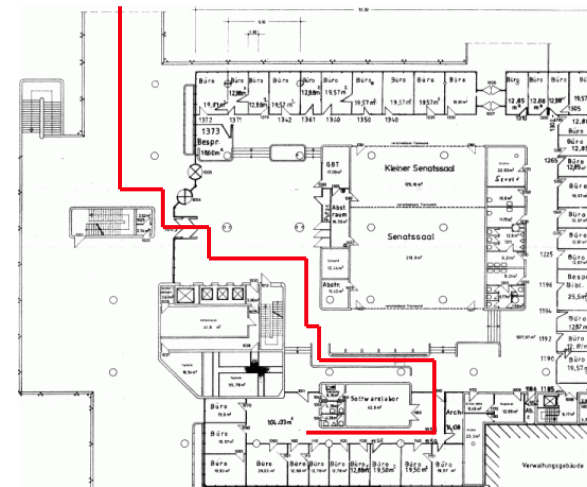
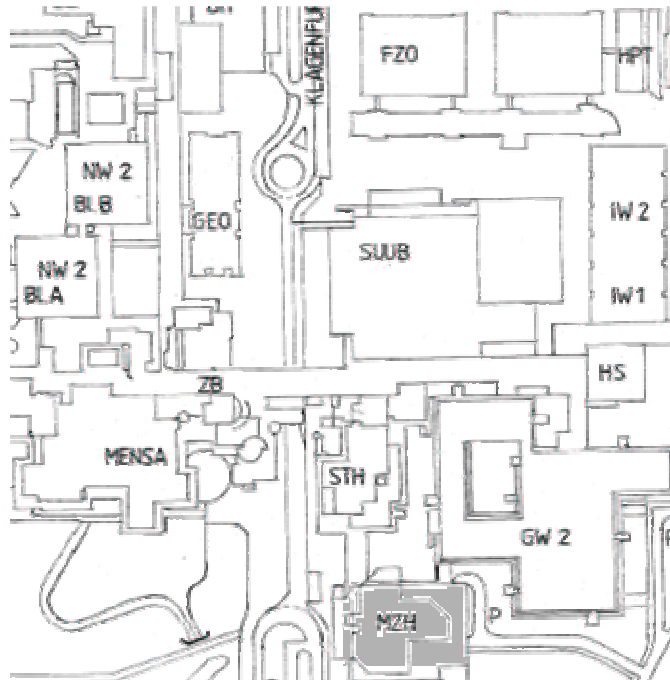
Indoor and Outdoor Navigation



► Buildings: IW + BIBA

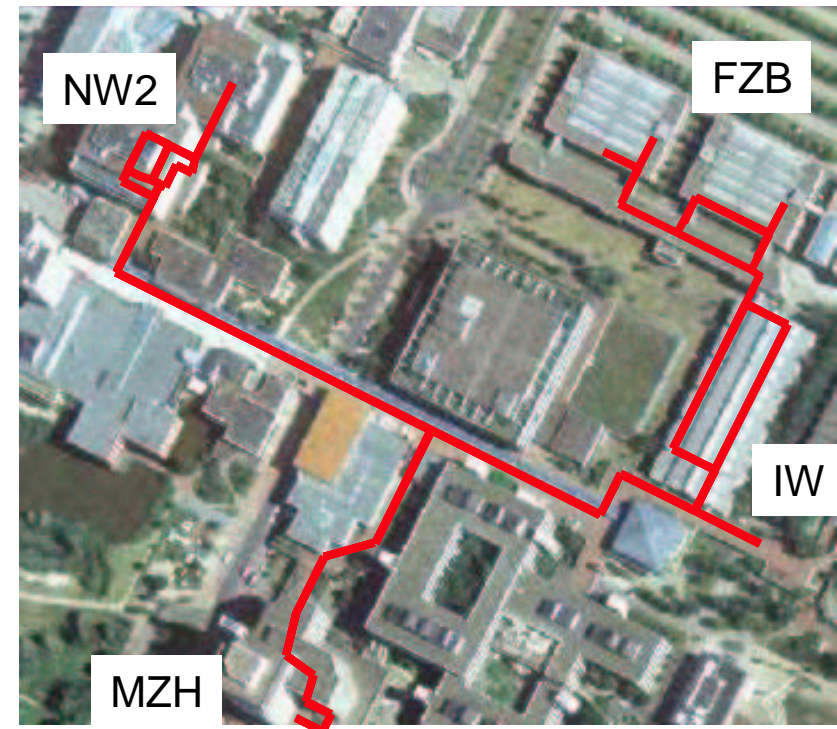
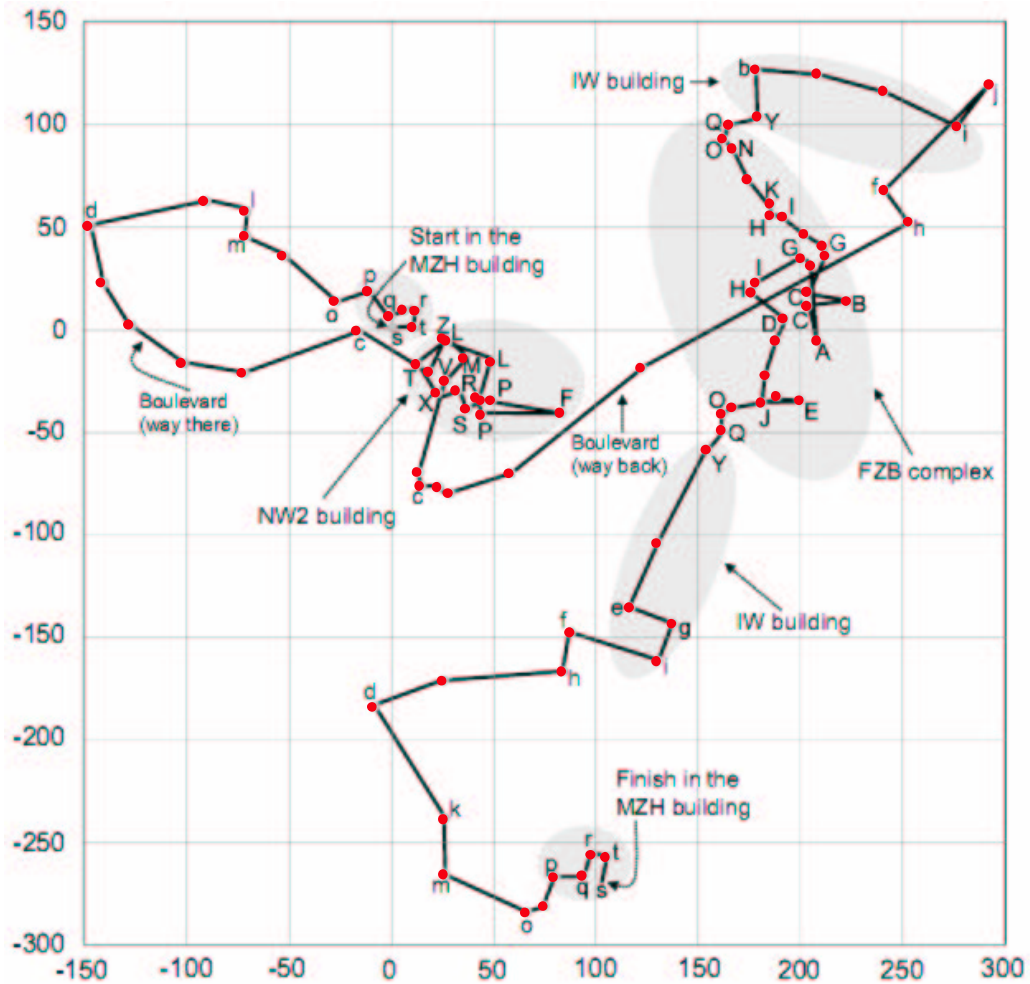


Indoor and Outdoor Navigation



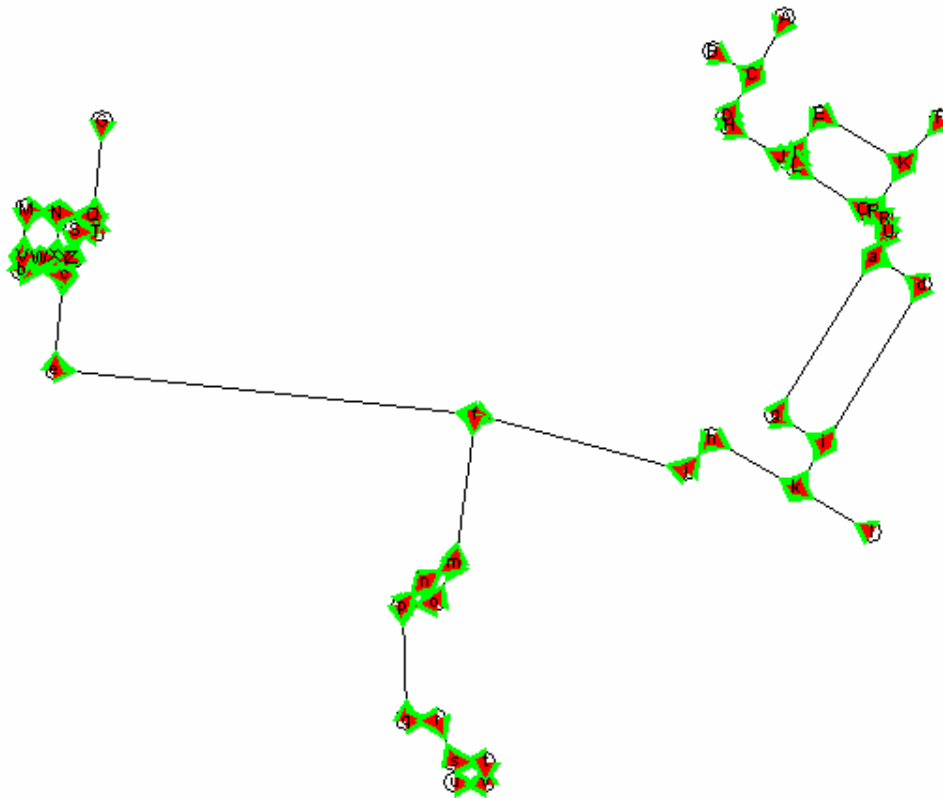
- ▶ **Building: MZH**
- ▶ **Overall length: 2176 m**

Matching Route and Route Graph





Results I

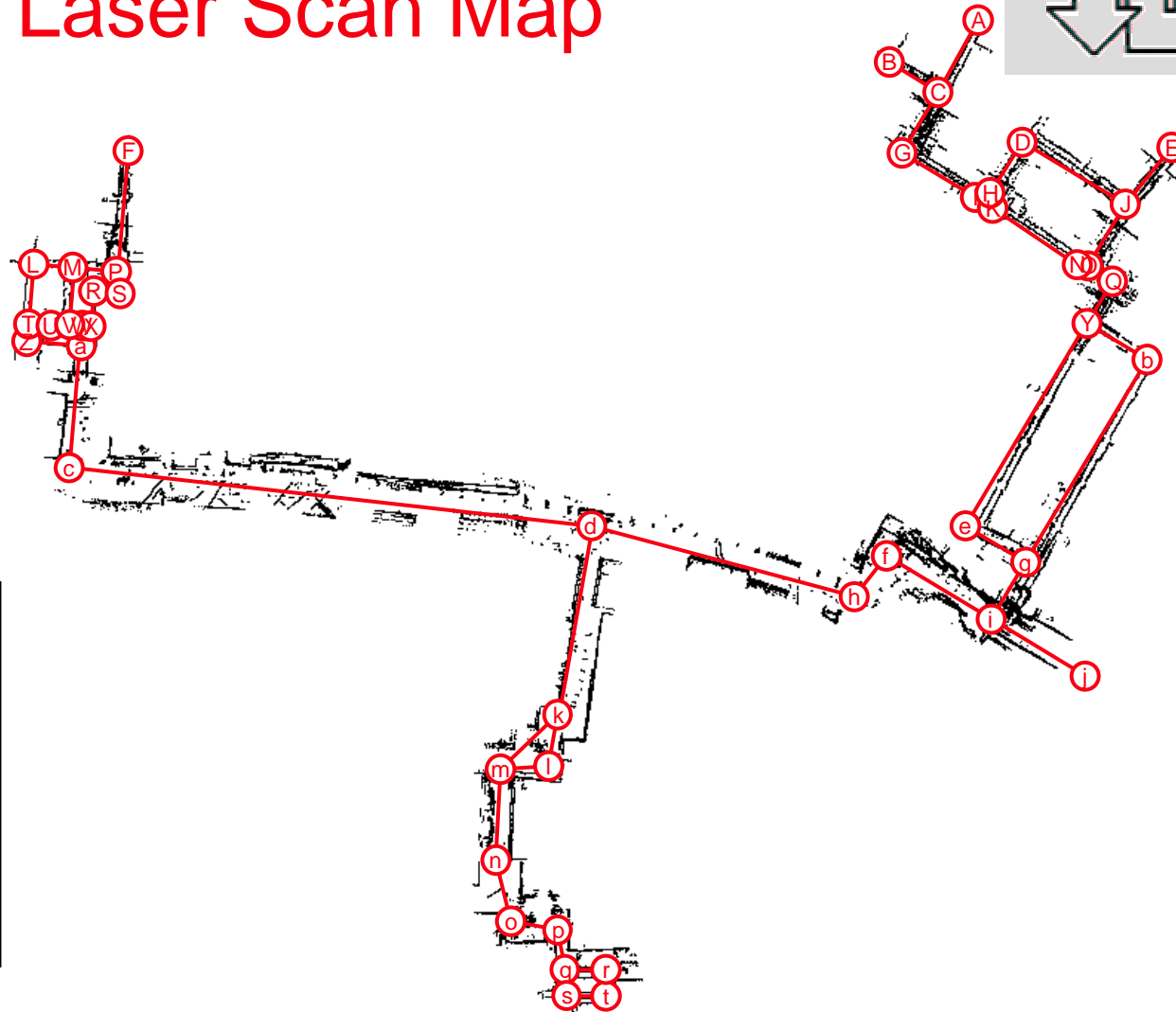
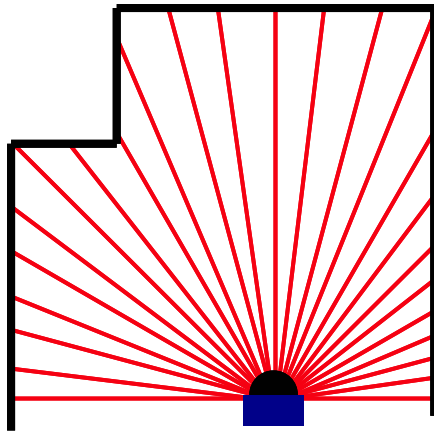


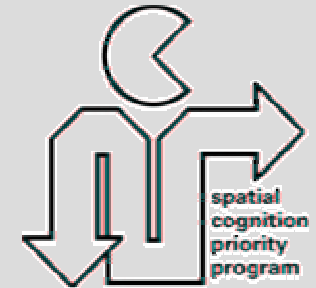
- ▶ Previous corner believed
- ▶ Previous corner not believed
- ▶ Most probable position

Intensity encodes confidence

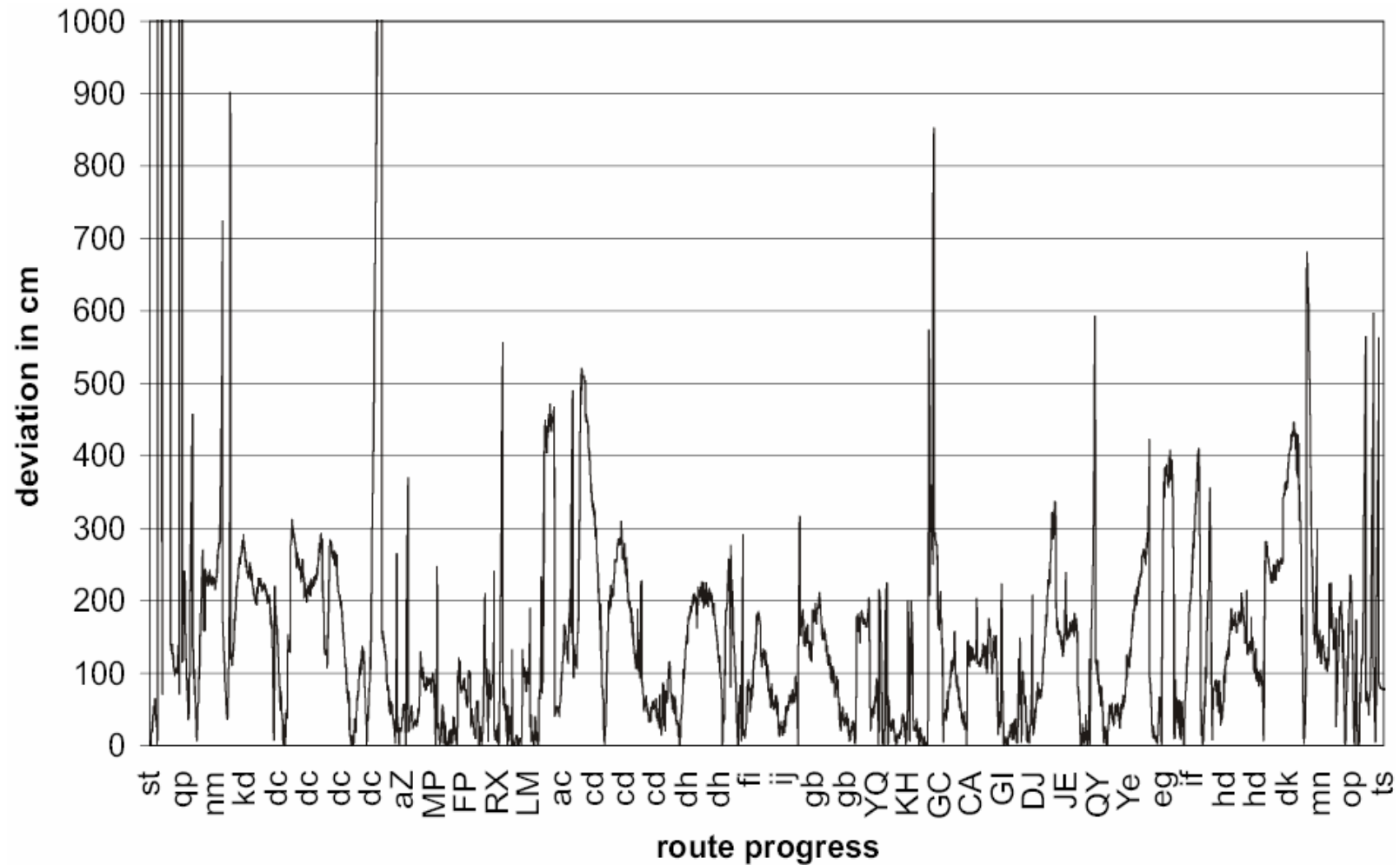
Speeded up by factor 70

Reference: Laser Scan Map





Results II





Contact & References

- ▶ Freksa, Habel, Wender (eds.)
“Spatial Cognition”, LNAI 1404,
Springer, 1998
- ▶ Freksa, Brauer, Habel, Wender (eds.)
“Spatial Cognition II”, LNAI 1849,
Springer, 2000
- ▶ “Spatial Cognition III”, to appear,
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- ▶ www.spatial-cognition.de

