

Cognitive Wayfinding Agents in Public Transportation Networks

Sabine Timpf (timpf@geo.unizh.ch)

Urs-Jakob Rüetschi (uruetsch@geo.unizh.ch)

David Caduff (caduff@geo.unizh.ch)

Geographic Information Science Center, University of Zurich
Department of Geography, Winterthurerstr. 190, CH-8057 Zurich, Switzerland

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Wayfinding

Wayfinding is a complex human activity involving moving along while evaluating alternatives and making decisions. It is defined as a spatial problem solving process with the three sub-processes decision-making, decision execution, and information processing. In our research we focus on the information processing aspect of wayfinding.

Our main scientific goal is a cognitively plausible model for the simulation of multi-modal wayfinding in urban environments using cognitive agents. The agents will travel from a given start to a specific destination using different transportation modes and adjusting to the constraints given by traffic networks and the spaces involved. The simulation can serve as basis for a mobile navigation service or it can be used in traffic microsimulations.

Simulation

In contrast to earlier work on wayfinding simulation we are working on a model that takes into account the interplay between knowledge in the head and knowledge in the world. We are interested in simulating the process of wayfinding itself in contrast to the simulation of memory processes. We identified at least three main stages of the wayfinding process: pre-planning, issuing instructions, and navigating. Additional processes are information gathering such as orientation, comparing external with internal evidence, and re-planning due to some external changes. Thus, the representation of the environment requires a detailed investigation.

In order to support the reasoning processes of the agent we need at least two different levels of detail in the environmental information: a less detailed version of the environment for the planning process and a more detailed version for the navigation process. We make a distinction between the (modeled) environment (ontological information) and the environmental information that is actively acquired by the agent (epistemological information) for wayfinding purposes.

Environment

In a recent paper, Rüetschi and Timpf (2004a) showed that there are two significantly different types of environments for wayfinding: those that exhibit a clear network structure (referred to as *network space*) and those lacking such a structure (referred to as *scene space*). Transportation

networks are clearly network spaces, and in the case of public transport networks, they are described by the timetable. However, the interchange nodes (transfer nodes) usually consist of large open spaces such as halls and station squares, thus qualifying as scene spaces. Graph-based models are an established and proven tool for the representation of network spaces, but for scene space no such models exist. Therefore we propose an alternative model based on image schemata and partial ordering (Rüetschi & Timpf, 2004b).

Major components of the environment, which are essential for wayfinding, are landmarks. We are developing a framework that allows the incorporation of landmarks in navigational tasks performed in urban areas. The incorporation of landmarks in multimodal wayfinding processes is important for reducing the cognitive effort put on navigators when trying to find a destination. The framework sets the base for deducing relevant landmarks and integrating them in the route generation process (Caduff and Timpf 2005). Therefore, we analyze and model the cognitive processes involved when using different modes of transportation when traveling in urban environments. The model will account for position, orientation and motion of travelers, as well as, the nature and characteristics of typical cues in the environment.

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