# Context-Specific Route Directions

Kai-Florian Richter

**Today's wayfinding assistance systems provide route directions that are significantly different to those generated by humans, resulting in a gap between what users expect and what the system delivers. This dissertation contributes to closing this gap by presenting a process that adapts instructions to environmental characteristics and a route's properties, thereby implementing principles of human direction giving. The process generates an abstract, relational specification of route directions, which can, for example, be externalized verbally.**

## 1 Introduction

In unfamiliar environments, people need assistance in order to reach their destination successfully. They need information on which actions to perform to get from their current location to their destination. Today, systems providing such information automatically are widely available, for example, internet route planners or car navigation systems. However, these systems generate instructions that are significantly different from human directions; consequently, these directions are cognitively demanding to process for a human wayfinder.

Accordingly, in recent years research in many areas (e.g., computer science, geography, linguistics, psychology) has addressed questions of human direction giving and understanding, and ways to improve existing wayfinding services. This thesis is set in that area; specifically, it looks at what can be exploited in an environment to support and faciliate communicating the actions that need to be performed in order to follow a route, and how this can be turned into an automatic process for generating route directions. A general claim is that to be useful, route directions need to be well memorable and they need to match well with the spatial situations encountered while following a route.

The main contributions of this thesis are threefold: it provides a thorough analysis of principles of human direction giving resulting in a systematics of elements (see next section); a generation process that implements cognitive principles and, especially, can deal with different types of landmarks (Section 3); and an implementation of this process that is flexible with respect to the route direction principles employed. It may serve as a test-bed for evaluating different combinations of such principles.

## 2 A Systematics of Route Direction Elements

To elicit the fundamental principles underlying an automatic generation of route directions, previous work on (human) route directions has been analyzed both from a cognitive and a representation-theoretic perspective, and the interrelationship between both perspectives has been identified.

From a cognitive perspective, three main properties of route directions can be identified. First, as a route is directed and sequential, instructions in route directions are also sequential, and ordered from origin to destination. Furthermore, most instructions use an intrinsic reference system with the (moving) wayfinder as reference object; accordingly, the relations *left* and *right* are well-defined. Second, landmarks play a crucial role; humans refer to them frequently. They are used to anchor actions in space, i.e. to link an action to a specific location (a decision point) along the route. And third, another important mechanism in human route directions is *spatial chunking* [2] that combines several instructions of consecutive decision points into a single instruction. For example, "turn left at the third intersection" is a combination of going twice straight and then turning left.

From a representation-theoretic perspective, a first important property is that different kinds of references involve different kinds of spatial knowledge to generate and interpret them. Cardinal directions, for example, rely on directional knowledge, whereas relating a landmark at a decision point to the wayfinder's route involves ordering information. Second, different instructions abstract from a detailed description of a decision point / action pair to different degrees. Compare, for example, an instruction such as "turn left at the intersection" with "follow the signs to the main station." These different degrees of abstraction result in a concept of granularity in route directions. And third, this granularity and especially spatial chunking result in instructions to be only implicitly represented for some of the decision points. Accordingly, route directions need to be generated such that these instructions are inferable. The analysis of route direction principles results in a systematics of different types of elements (see Table 1). These elements are grouped according to their granularity.

| Global References | Environmental Structure | Path and Route |
|---|---|---|
| cardinal directions | edges | egocentric references |
| global landmarks | districts | landmarks at decision point |
| | slant | landmarks between decision points |
| | | distant landmarks |
| | | linear and areal landmarks |
| | | path annotations |

Table 1: Systematics of route direction elements. Elements are grouped on three levels according to their relation to the route.