Interpreting Motion Expressions in Route Instructions Using Two Projection-Based Models

Yohei Kurata and Hui Shi

SFB/TR 8 Spatial Cognition, Universität Bremen / (ykurata,shi)@informatik.uni-bremen.de

Motivation
Mobile robots and intelligent vehicles that navigate in human living spaces, such as the intelligent wheelchair Rolland\(^1\), should equip with an ability to communicate with human users about their action plans through natural language.

Two types of expressions people may use:

- **Goal-Oriented Expressions**
  e.g., go to the front of ... go behind ...
  go towards ...
  go into ...

- **Path-Centric Expressions**
  e.g., pass ... on the left
  go along ...
  go towards ...
  go into ...

Research Goal
To model the semantics of path-centric motion expressions using projection-based spatial models.

Spatial models that project a frame of spatial reference onto a space, by which the spatial arrangements of objects are distinguished.

Analysis

Scenario 1: if the landmarks are represented by points

Model: Double Cross \(^2\)

Correspondence between Motion Expressions and Spatial Patterns:
- there is a clear correspondence

Scenario 2: if the landmarks are represented by regions

Model: RfDL\(_{3-12}\)

Correspondence between Motion Expressions and Spatial Patterns:

(i) When the route and the landmark are disjoint
- the correspondence is sometimes ambiguous

(ii) When the route intersects with the landmark
- topological relations can be used to model the expressions

In this scenario, people typically describe a motion using topological information (i.e., how the route intersects with the landmark). Thus, topological line-region relations \(^4\) can be used as a basis for capturing typical expressions:

Interestingly, when the landmark is convex, every RfDL\(_{3-12}\) pattern is mapped to a unique topological line-region relation \(^5\). Moreover, even if the landmark may not be convex, 77% of RfDL\(_{3-12}\) patterns are mapped to a unique topological relation \(^5\).

This indicates that RfDL\(_{3-12}\) patterns are useful for capturing not only directional, but also topology-featured motion expressions.

References


