ONTOLOGY within the SFB/TR8 in Spatial Cognition at the Universities of Bremen and Freiburg

SFB/TR 8

The activities described here are part of the Transregional Cooperative Research Center in Spatial Cognition of the Universities of Bremen and Freiburg funded by the German Research Council DFG ("Sonderforschungsbereich/Transregio" Project SFB/TR 8). The Research Center was launched in January 2003 for an initial phase of 4 years. Two subsequent phases each of 4 years duration are planned. The first phase consists of 12 projects with a total funding of 5.5 million Euro.

The Ontology effort of the Research Center is carried primarily by the subprojects OntoSpace (Bateman et al.) and SPIN (Krieg-Brückner et al.). An Ontology Working Group is also in place in order to coordinate ontology development and usage across all projects in the Research Center.

The primary goals of the ontology-related projects are:

- to construct a **general common sense ontology** suitable for representation in all of the areas investigated in the Research Center, but focusing particularly on spatial representations and information relevant for robotic movement in space: including size, shape and colour representations, routes, obstacles and so on.
- to construct a **general linguistically motivated ontology** for interfacing between all computational components developed within the research center and natural language technology components for natural dialog.
- to investigate **formal modelling techniques** with varied computational properties as applied to both the ontologies individually and to their mutual relationships.

The groups involved combine the following areas of expertise:

John Bateman: One of the original developers of the Penman Upper Model linguistic ontology used for interfacing between natural language generation components and domain models and for organising domain models (1988-1992); subsequent developer of generalised versions of this ontology for multilingual natural language technology (1994-1998).

Scott Farrar: Developer of the ontology aspects of the EMELD project at the University of Arizona (1998-2003) for representing linguistic information concerning the languages of the world in a semantic web appropriate form: GOLD (General Ontology for Linguistic Description) expressed in OWL.

Bernd Krieg-Brückner: Leader of the formal methods group of the Informatics department with expertise in formal specification, secure systems and cognitive robotics. Member of the IFIP working group WG 1.3 "Foundations of System

Specification" and its Common Framework Initiative for Specification and Development (CoFI). Results of this initiative include a Common Framework for Algebraic Specification captured in the language CASL: the Common Algebraic Specification Language.

Till Mossakowski: Participator in the CoFi CASL development and leader of tools working group. Tools developed within the CoFi initiative include The HOL-CASL system using the encoding of CASL into second-order logic to connect CASL to the Isabelle theorem prover and the generic graphical user interface IsaWin.

Basic specifications in CASL denote classes of partial first-order structures: algebras where the functions are partial or total, and where also predicates are allowed. Subsorts are interpreted as embeddings. Axioms are first-order formulae built from definedness assertions and both strong and existential equations. Sort generation constraints can be stated.

Methods and starting points:

The constructed ontologies will draw crucially on the international state of the art in ontology work in order to avoid duplication of effort. This is being evaluated and will be extended as necessary to support the particular requirements of components explored by the Research Center.

Common sense ontologies

An initial study has suggested that an effective starting point for the common sense ontology is offered by the DoIce (Guarino and co-workers) and BFO (Smith and co-workers) efforts. We are now investigating to what extent these can be combined and extended to cover spatial phenomena, such as those listed by the DAML-Space initiative—with whom however we are not co-operating. Formalisations of qualitative spatial reasoning such as those investigated within the Leeds Qualitative Spatial Reasoning group (Cohn, Bennett) are also being considered for integration.

Linguistic ontologies

For the linguistic ontology we are starting with the Generalized Upper Model (Bateman *et al*.) and considering extensions motivated by extensive spatial semantics such as those of Eschenbach and Habel (Hamburg) and Levinson (Nijmegen). A particular orientation at present is to place the modelling of **function and task** more in the foreground as this has been neglected in past linguistically motivated ontology accounts.

Formalization and specification

For both aspects the formalization expertise of the formal methods group is being relied upon. Algebraic specification (e.g., CASL) and robust tools for working with large-scale formal specifications are being investigated with respect to their suitability for supporting ontology development, maintenance and re-use. Important is the high degree of customization and reuse provided by tailored logics of varying formal complexity. Import/export mechanisms between these formal specifications and the developing W3C OWL specification will be maintained.