Representation of Spatial Knowledge for Configuration*

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Extended Abstract

Spatial reasoning for configuration is the task of finding a position and if neccessary the dimension of geometrical objects according to a set of spatial relations. The geometric objects are abstractions of the components which have been chosen during the configuration and of regions like "*at eye level*" and "*minimum distance*". The spatial relations are any relations needed in an application to describe spatial contraints like "A has to be *left of* B" or "C must not be *above* D".

Two main aspects have to be taken care of. First the geometric objects and the spatial relations have to be represented appropriately. Second the lay-out of the geometric objects according to the spatial constraints has to be generated.

Representation

The representation of geometric objects and spatial relations is based on the general qualitative spatial scenario which has been developed by Kamp and Richter ([Kam93], [KR93]). This scenario is a general framework for representing qualitative spatial relations between geometric objects whose shape can be approximated by a polyhedron or by an assembly of polyhedra [2]. Intervals are extended into two and three dimensions by using respectively parallel lines or parallel planes as endpoints of intervals. Assigning a direction to each interval by defining a starting point and an end point for each interval the interval relations of Allen's interval algebra ([All83]) for temporal reasoning can be employed for representing qualitative spatial relations.

For each interval relation there exists a definite representation in terms of relations (equations and inequations) between the endpoints of the intervals. Therefore the qualitative spatial relations are unambiguously transformed into a quantitative representation.

The general qualitative spatial scenario builds a framework from which a suitable part is chosen for the representation of a concrete application. Thus the

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[2] or by polygons or intervals in two-dimensional or one-dimensional space respectively

complexity of the representation and reasoning is adjusted to the complexity of the application while the principal method of representation and reasoning stays the same.

Generation of a lay-out

A lay-out can be generated by constructive methods like generate-and-test as e.g. in [Fle89] or [Sch93] or by reductive methods like constraint propagation as e.g. in [KG92] or [BF91]. Both complement each other. Constraint propagation can prune the search space for generate-and-test while generate-and-test can generate a solution for underconstraint problems or handle requirements that cannot be formulated with constraints ([FBCF92]).

So far the focus has been on constraint propagation. In the process of solving a lay-out problem qualitative constraint propagation is used for pruning the search space for the subsequent quantitative propagation by an algebraic constraint solver.

Outlook

Further research will focus on determining the complexity of certain classes of lay-out problems and developing heuristics for the generation of lay-outs.

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