ABSTRACT

Title of Thesis: Conversion of the Connectivity Representation of a Design to a Solid Model Using Graph Grammars and Geometric Constraint Satisfaction Techniques

Degree Candidate: Kerkar Sameer Manohar

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Thesis directed by: Dr. Linda Schmidt
Mechanical Engineering

We seek to develop techniques and tools to automate the design process. Graphs are powerful representational tools that are used to describe objects at various levels of abstraction. This research uses a graph grammar to add information required for mechanical assembly to the graph connectivity representation of the design. The information added to the connectivity graph determines the orientations of the members of the design, creating an augmented graph called the constraint graph, which constrains the spatial positions that the members can take. The process of converting the constraint graph to a feasible model requires the satisfaction of spatial and functional constraints. The problem is modeled as a Constraint Satisfaction Problem and solved operationally using a backtracking search technique. GGREADA, a generative design algorithm, provides the initial connectivity graph containing a set of members and the connectivity relationship between them. Genesis, a grammar-based solid modeler, provides the environment to work with grammars, a logic engine to resolve constraints, and a solid modeler to reason with solids and display a solid model output of the design.