ABSTRACT

A Non-Manifold Shape Representation. (August 1993)

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The part representation, used by conventional geometric modeling systems, is incomplete in terms of the part descriptive information needed for concurrent engineering. The conceptual model of the part, the detailed design, the model of the part geometry, and the model of the three-dimensional mesh of a part each use different representations, often modeled in independent systems. The multiplicity of incompatible representations causes a high impedance to information flow between the conceptual design, engineering design, and analysis activities. The maintenance of different abstractions of the same part in different representations causes problems of data redundancy and data inconsistency between models. The research results presented in this dissertation provide a representation for maintaining a common schema for models in design, analysis, and manufacturing. The approach is based on non-manifold geometric representation augmented by rules and frames. The rule-based component is used to define logical implications and actions associated with the geometry, whereas the frame-based component is used to define stereotypical situations and taxonomic class membership relations concerning geometric components. This dissertation addresses the application of the representation results to three critical needs of concurrent engineering and CAD/CAE/CAM: (1) feature definition, (2) feature recognition, and (3) feature interaction.