

ABSTRACT

AN ENGINEERING CONSTRAINT HANDLING AND OPTIMIZATION SYSTEM FOR INTEGRATED PRODUCT DEVELOPMENT

by

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Integrated product development is the future of product development. Integrated product development is a process where both upstream (e.g., functional requirements, styling and cosmetic features, and packaging) and downstream (e.g. manufacturing considerations, testing, dunnage, and disposal) requirements of a product are handled concurrently with its geometry construction. In this research, the so-called ECHO (Engineering Constraint Handling and Optimization) system for integrated product development has been developed. A unique feature of this system is that it can explicitly represent and process both the upstream and downstream requirements. These requirements are represented in the form of constraint networks, rule networks, and assessment matrices. By solving for all of the feasible solutions, the ECHO system instructs the geometry construction, and thus ensures that both upstream and downstream requirements are reflected in the design.

In its simplest form, the ECHO system consists of four tightly integrated components; a CSP (Constraint Satisfaction Problem) solver, and optimization solver, an expert system shell, and a solid modeler. The expert system shell and sold modeler are two well known commercial software, namely, Smart element and Pro/ENGINEER. They are seamlessly integrated into the ECHO system with the developed "Integration Interface." Through this "Integration Interface," the ECHO system instructs and manipulates the geometry construction in the solid modeler. By inheriting the geometry data through the "Integration Interface," the ECHO system also provides a user-friendly, on-line interactive rule network development and modification environment. A case study for automotive piston development has been implemented to illustrate the capability and use of the ECHO system.