A System for Creating and Manipulating Mechanical Part Models based on PDES (Summary)

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Abstract: The Automated Manufacturing Research Facility of the National Institute of Standards & Technology is moving towards the use of PDES-based definitions for mechanical parts. This effort is in conjunction with NIST's designation as the National PDES Testbed. Currently, commercial CAD systems do not directly support the use of PDES-based models and are generally not capable of representing much of the information specified by PDES in an integrated fashion. We are implementing a system to address these limitations of CAD systems, demonstrating the functionality required for PDES-based part modeling. The design issues, architecture, and functionality of the system are presented.

1.0 Background
The Product Data Exchange Specification (PDES) is an emerging standard that is intended to address the problems of data exchange and representation for a variety of manufacturing enterprises. NIST is playing an integral role in the coordination of the various international committees that are developing PDES. Additionally, NIST has a long-standing research program that addresses the problems of integrating and developing the systems required for automated manufacturing of mechanical parts. The touchstone of NIST's work in this area is the Automated Manufacturing Research Facility (AMRF) which is a fully equipped testbed for investigation and technology transfer of Computer Integrated Manufacturing (CIM) concepts.

Consequently, work is underway to incorporate PDES into the individual systems that contribute to the production and inspection of mechanical parts in the AMRF. By incorporating PDES into the AMRF, we not only advance the possibilities for CIM research in the AMRF, but also provide a realistic environment for the test and validation of the standard.

2.0 Software Architecture
Application systems such as design, process planning, and inspection that are to make use of PDES data need to have generic tools for using such data within the application environment. A software architecture for embedding the required functionality within the application systems has been developed. The goals guiding the development of the architecture were that it should be easily adaptable to changes in the evolving PDES standard; that it should insulate application software from the details of PDES and its implementation, and finally that the architecture be sufficiently generic so that related, but different, applications could be built on it.

The result is the multilayer architecture illustrated in Figure 1. The Data Level comprises the physical representations of PDES part models. The Representation Access Level includes the access software that provides an interface to the PDES data representations. The Representation Transformation Level provides a mechanism for exchanging PDES data between data representations. The Application Resource Level implements functions that are useful across a broad spectrum of PDES-based applications. This level is considered a software toolkit that is to be used as a resource for developing specific applications. The Application Level is where specific application software, such as part model design, reside. The User Level is the layer at which human users interact with specific applications.

3.0 Application Software
The initial use of this architecture is in the implementation of a system that will allow for the design of mechanical part models. The design system employs a graphical user interface to provide the designer with the ability to define the geometry, features, and tolerances associated with a mechanical part. In some ways this system mimics the functionality found in contemporary Computer Aided Design systems (CAD); however, CAD systems that are currently available do not adequately represent many of the relationships between features, tolerances, and geometry that are required in an automated manufacturing environment.
Figure 1: Application Architecture