IDEA GROUP PUBLISHING **ITB13695**

701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.idea-group.com

This paper appears in the publication,
Artificial Intelligence and Integrated Intelligent Information Systems: Emerging Technologies and Applications
edited by X. Zha © 2007, Idea Group Inc.

Chapter XVIII

Document-Driven Design for Distributed CAD Services

Yan Wang, University of Central Florida, USA

Abstract

Current CAD systems only support interactive geometry generation, which is not ideal for distributed engineering services in enterprise-to-enterprise collaboration with a generic thin-client service-oriented architecture. This chapter presents a new feature-based modeling mechanism, document-driven design, to enable batch mode geometry construction for distributed CAD systems. A semantic feature model is developed to represent informative and communicative design intent. Feature semantics is explicitly captured as trinary relation, which provides good extensibility and prevents semantics loss. Data interoperability between domains is enhanced by schema mapping and multi-resolution semantics. This mechanism aims to enable asynchronous communication in distributed CAD environments with ease of design alternative evaluation and reuse, and improved system throughput and utilization.

Introduction

With the recent occurrence of outsourcing, collaborative product development among designers, manufacturers, suppliers, vendors, and other stakeholders is one of the keys for manufacturers to improve product quality, reduce cost, and shorten time-to-market in today's

Copyright © 2007, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

global competition. Collaborative design is the new design process where multidisciplinary stakeholders participate in design decision-making and share product information across enterprise boundaries in an Internet-enabled distributed environment.

Different from traditional standalone CAD systems, interaction between users and systems in collaborative design is a new challenge. Usually software systems may run in two modes: interactive mode, in which commands are entered and executed one at a time; and batch mode, in which commands are listed in a batch file sequentially and execution of the batch file finishes all commands automatically without user interaction. The issue of batch mode geometry generation for distributed CAD is discussed in this chapter. Current CAD systems only support interactive geometry generation. CAD users create geometric model by defining features step by step. These CAD systems can become fat clients in a distributed CAD environment in which clients perform the bulk of data processing operations locally. However, in a simple Web-based environment, thin-client CAD tools mainly with visualization functions cannot perform complex editing tasks locally. The majority of data processing requests are sent to the server. Synchronous communication will become the bottleneck of the overall system performance. Thus, synchronous and interactive model generation is not ideal for a distributed CAD system in which thin-client infrastructure is used in regular enterprise-to-enterprise collaboration.

Intense human involvement is a challenge to automate the geometry creation process. Usually as the first step of design implementation, geometry creation heavily depends on engineers' skills using CAD tools. In contrast, some other design processes, such as data translation, mesh model generation, finite element analysis and simulation, and process planning, can be done in batch mode with little human intervention. Batch mode processing can increase throughput of tools and reduce the cost of service providers. It also reduces human errors and enables better design data management and knowledge reuse.

Automation of the geometry creation process will enable the geometric modeling process to be easily incorporated in a distributed CAD environment such that the work load of the client and communication channel can be both reduced. It will enable an integrated automation loop of CAD, CAE, and optimization in the design alternative evaluation. In this chapter, we propose a new geometry generation mechanism, document-driven design, for batch mode feature-based geometric modeling considering ease of communication and reuse. Document-driven design (DDD) is the design process in which the model is high level and informational. Documents give specifications and instructions for model generation. In traditional model-driven design (MDD), the model is low level and normative. Model generation and evaluation are tightly coupled so that the modeling process has to be in an interactive mode. In the proposed DDD mechanism, the textual document is the only format of user input, and communication is based on the document. Document-driven process flow can simplify engineering design and analysis processes, thus accelerating design cycles. Furthermore, the semantics of features is not captured actively and maintained in existing modeling process. Interoperable feature model exchange and sharing still cannot be achieved with good scalability with existing one-to-one mapping methods. A semantic feature model is developed for the DDD mechanism in order to capture complete requirement information and geometry specification in the document with hierarchical native engineering semantics embedding.

Copyright © 2007, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

25 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/document-driven-design-distributed-cad/5314

Related Content

C2B Coordination and Optimization Strategy of Enterprise Supply Chain for Internet of Things E-Commerce Management

Jing Yiand Xiao Zeng (2025). *International Journal of Intelligent Information Technologies (pp. 1-26).*

www.irma-international.org/article/c2b-coordination-and-optimization-strategy-of-enterprise-supply-chain-for-internet-of-things-e-commerce-management/373203

Secured Transmission of Clinical Signals Using Hyperchaotic DNA Confusion and Diffusion Transform

S. J. Sheela, K. V. Sureshand Deepaknath Tandur (2021). *Research Anthology on Artificial Intelligence Applications in Security (pp. 782-805).*

www.irma-international.org/chapter/secured-transmission-of-clinical-signals-using-hyperchaotic-dna-confusion-and-diffusion-transform/270626

Modeling Fault Tolerant and Secure Mobile Agent Execution in Distributed Systems

H. Hamidiand K. Mohammadi (2006). *International Journal of Intelligent Information Technologies (pp. 21-36).*

www.irma-international.org/article/modeling-fault-tolerant-secure-mobile/2395

Creating Dynamic Spaces in Higher Education: Modern Shifts in Policy, Competencies, and Governance

Henry Nyabuto Onderi (2025). *Impacts of Generative AI on the Future of Research and Education (pp. 97-116).*

www.irma-international.org/chapter/creating-dynamic-spaces-in-higher-education/358769

Multicriteria Decision-Making Method Under a Single Valued Neutrosophic Environment

Shapu Ren (2017). *International Journal of Intelligent Information Technologies (pp. 23-37).*

www.irma-international.org/article/multicriteria-decision-making-method-under-a-single-valued-neutrosophic-environment/187179