



Product modeling from knowledge, distributed computing and lifecycle perspectives: A literature review



Guolin Lyu^a, Xuening Chu^b, Deyi Xue^{a,*}

^a Department of Mechanical and Manufacturing Engineering, University of Calgary, Calgary, Alberta T2N 1N4, Canada

^b School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

ARTICLE INFO

Article history:

Received 22 June 2016

Received in revised form 14 October 2016

Accepted 2 November 2016

Available online xxx

Keywords:

Computer Aided Design (CAD)

Product modeling

Product knowledge

Distributed computing

Product lifecycle

ABSTRACT

Compared with Computer Aided Design (CAD) to use computer graphics technologies to describe geometric information for the product design, many new methodologies and systems have been developed in the past decades in product modeling to extend the functions of the traditional CAD systems. In the product representation aspect, in addition to the design solution usually modeled by geometric descriptions, modeling of product knowledge has been widely investigated to describe the rationale for creation of the product solution. In the information technology aspect, in addition to the traditional computing tools such as computer programming languages and object oriented design, distributed computing technologies particularly Internet, web and cloud computing tools have been widely employed to implement product modeling systems. In the product development process aspect, in addition to the design solution, other product lifecycle aspects such as manufacturing, maintenance and service have been modeled and integrated into the same environment. In this literature review, the recent advances of research on product modeling in product representation, information technologies and product development process are investigated from these three new perspectives: knowledge, distributed computing, and product lifecycle. In addition, traditional methodologies and future challenges in computer-based product modeling are also discussed.

© 2016 Elsevier B.V. All rights reserved.

Contents

1. Introduction	2
2. Traditional methods for product modeling	3
2.1. CAD-based product geometric modeling	3
2.2. Data exchange for product modeling	3
3. Recent research in product modeling	3
3.1. Knowledge perspective for product modeling	3
3.1.1. Modeling of design geometry creation process in STEP	3
3.1.2. Common schemes for non-geometric product information modeling	4
3.1.3. Modeling of design repositories	4
3.1.4. Modeling of product knowledge with ontologies	5
3.1.5. Product modeling languages	5
3.1.6. Product modeling based on functions and rules	6
3.2. Distributed computing perspective for product modeling	7
3.2.1. Web-based product modeling formats	7
3.2.2. Distributed product modeling system architectures	7
3.2.3. Distributed product modeling systems	7
3.2.4. Cloud computing for product modeling	8
3.3. Lifecycle perspective for product modeling	8

* Corresponding author.

E-mail address: dxue@ucalgary.ca (D. Xue).

3.3.1.	PLM modeling	9
3.3.2.	Product modeling considering different lifecycle aspects	9
4.	Future research trends	10
5.	Conclusions	11
	Acknowledgements	11
	References	11

1. Introduction

Development of a product is usually conducted through a sequence of processes including acquisition of customer requirements, definition of design specifications, generation of design concepts, selection of product architecture, configuration and key parameters, creation of design details particularly design geometry, planning of manufacturing process and resources, production and control, product distribution, sales and marketing, service and maintenance, and recycle and disposal. With the advances of computer technologies, many of these product development activities have been automated by computer tools and systems such as Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Aided Process Planning (CAPP), and Computer Integrated Manufacturing (CIM) [12]. With these computer tools and systems, designs with good functionalities can be created within short product development lead times for satisfying customer requirements and reducing production costs. Among these different computer-based product development systems, product modeling serves the key role to associate and integrate these computer-based product development activities into the same environment [101].

Development of computer-based product modeling systems was started from the implementation of CAD systems to model design geometries in 1960s. Since then, the geometry-based product models have been used for different product development purposes such as Finite Element Analysis (FEA) to evaluate the created design by meshing the design geometry, Computer Aided Manufacturing (CAM) to create the design geometry by machining operations, and Computer Aided Process Planning (CAPP) to

identify the manufacturing geometric features to be removed as well as the operations and their sequence to remove the manufacturing features [12]. Many computer graphics methods, especially the 3-D solid geometric modeling methods including Constructive Solid Geometry (CSG) and Boundary Representation (B-rep), have been developed to implement various commercial CAD systems and their extensions such as FEA, CAM and CAPP systems [102]. CAD-based product geometric modeling serves as the key element to associate and integrate these commercial computer-based design, analysis and manufacturing tools into the same environment.

In addition to the traditional geometry-based product modeling methods that have been widely implemented into many commercial systems, great efforts have been devoted into the development of new methodologies for product modeling and implementation of these methodologies as prototype systems and applications. We classify these methodologies into three aspects: product representation, information technology and product development process, as shown in Fig. 1.

• *Product representation perspective*

Product modeling from product representation perspective focuses on how a product should be modeled. The traditional methods widely used in the commercial systems are primarily related to modeling of the product using its geometric descriptions. Since design geometry only represents design solution achieved by design engineers, researches on modeling of design knowledge that serves as the rational to create design solutions have been widely conducted.

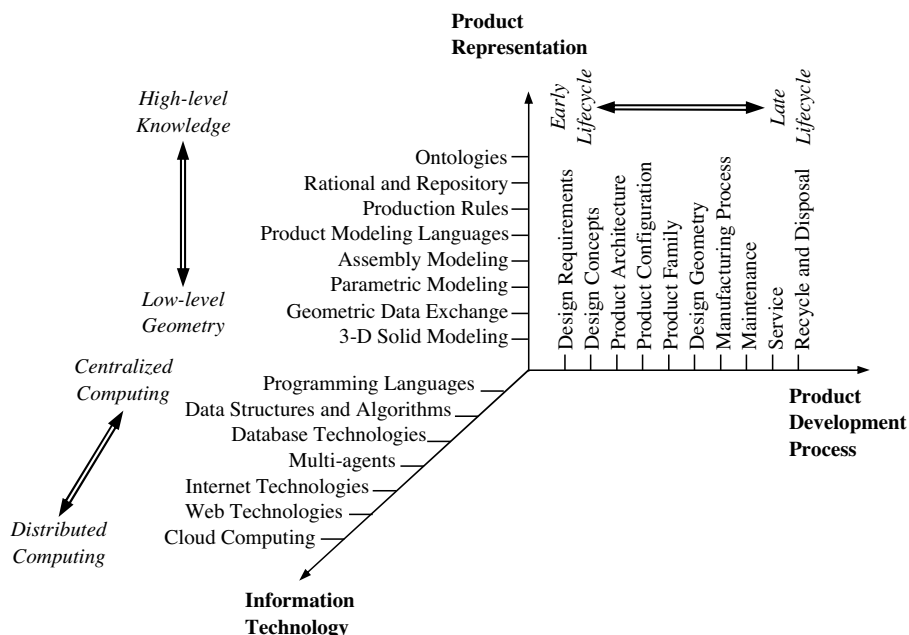


Fig. 1. Three different perspectives in product modeling.

Download English Version:

<https://daneshyari.com/en/article/4965547>

Download Persian Version:

<https://daneshyari.com/article/4965547>

[Daneshyari.com](https://daneshyari.com)