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Associations management and change propagation in the CAD assembly

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ABSTRACT

Engineering changes (ECs) are a kind of changes and/or modifications in forms, fits, functions, materials or dimensions of products and its constituent components. ECs usually stimulate a series of downstream changes. Therefore multiple disciplines and responsibilities are involved in managing those changes. The management of ECs affects the agility of the product development process of the enterprise. But Computer Aided Design (CAD) systems are limited in supporting the multi disciplinary teamwork in engineering change management (especially when they are distributed in terms of location and time). So, in this context of engineering change management we establish our work concerning engineering change propagation from Part to Assembly. This research paper explain the CAD Management Model, which enable us to better manage the Digital Mockup (DMU) and propagate changes to the hole assembly after a modification that affects one of its component, that has been sent to a partner modified an then reinserted. The aim of this model is to easily and automatically propagate this change by creating certain necessary correspondences which aim to precise the targeted entities (that will be affected by the change propagation).

1. Introduction

Today challenges are, first the deadlines, the cost and the quality. Putting a product on the market as soon as possible becomes a major objective. The product must be: cheap, and of good quality. In addition, the life cycle of a product is becoming increasingly short. So constant innovation, to renew the product, is becoming important. The geometrical definition of a product progress continuously, through the work of different specialists who use, analyze and modify the existing information, make decisions and take action. So, the risk to lose information increases, especially when some modifications occur. Whence come out the idea to build a Model to manage those changes, and especially to facilitate the user's task. Therefore some scenarios of change propagation are threaded in order to quickly, easily and systematically propagate a change that affect a part of the assembly (after the user intervention) to the rest of the assembly. To facilitate this task some correspondences have to be done, so that the entities which will be targeted by the change propagation are identified. After identifying those entities the change propagation is becoming easier, we have just to detect the modification and carry out the necessary adjustment without any risk to lose the model coherence or to affect wrong entities. This paper is organized as follows. First, a conceptual approach is proposed, to structure the problem at hand. A literature review follows, covering change management and the propagation of change. The proposed approach and algorithms utilized to provide the desired tool enabling the propagation of changes and assisting users are detailed next, followed by the model validation results. The conclusions and perspectives for this work are presented at the end.

2. Literature review

During the last few years, several works have focused on change management. In this context Fouda et al. [1] have proposed a precedence graph generation system for product components, in order to improve CAD assembly management. He has harnessed the associations between components; described physical contacts and the order of insertion as well as relative motion and stability. Also a fast assembly system was proposed by Li et al. [2], based on TAFs (typical assembly features). The mechanism is mainly based on the assembly features and also on the possible constraints

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between them. It enables first to reduce the complexity of the assembly process, and moreover to effectively manage its components. Concerning the product and assembly relationships management in the concurrent engineering and product life cycle management (PLM) domain, a novel approach to integrate assembly process engineering information and knowledge in the early phases of the product development process have been developed by Demoly et al. [3]. Their approach – called Skeleton geometry-based Assembly Context Definition (SKL- ACD) – enables the control of the product modeling phase by introducing skeleton entities consistent with the product relationships and the assembly sequence planning information. The NSM (Neutral Skeleton Model) can be developed from Part 42 of ISO 10303 STEP [4], and also from neutral modeling commands that was defined in previous macro-parametric studies [5–7]. Li et al. [8] present a system that analyze the assembly and use the data available from a CAD model to generate assembly sequences. The created system also considers the user input as a kind of assembly constraint. The system is able to produce a set of ranked feasible assembly sequence plans for an operator to evaluate. A matrix approach has been adopted to process the information retained from a CAD model. A Neutral Reference Model about Representation and Propagation of Engineering Change Information in Collaborative Product Development is developed by Hwang et al. [9]. In the same context of changes propagation Louhichi et al. [10,11] proposed an approach which first; consider the associations between the initial work package objects and the modified work package objects, then the associations between the modified work package objects and the DMU, where the evolution of these objects (modified) is spread to the DMU. On the other hand Yin et al. [12] used topology faces as basic processing units and focused on the constraint relation between topology faces to develop a method for change propagation analysis from aircraft to assembly tooling, which assists designers to detect changes efficiently and assess the change influence qualitatively in a uniform way. the same approach based on the existing constraints and topological faces was used by Eltaief et al. [13]. An important question is how designers can be made aware of the impact of a proposed change before they commit. Eger et al. [14] focuses on this question, they discuss the links between the product component, process and people domains that interact during product development, listing limiting factors that make change

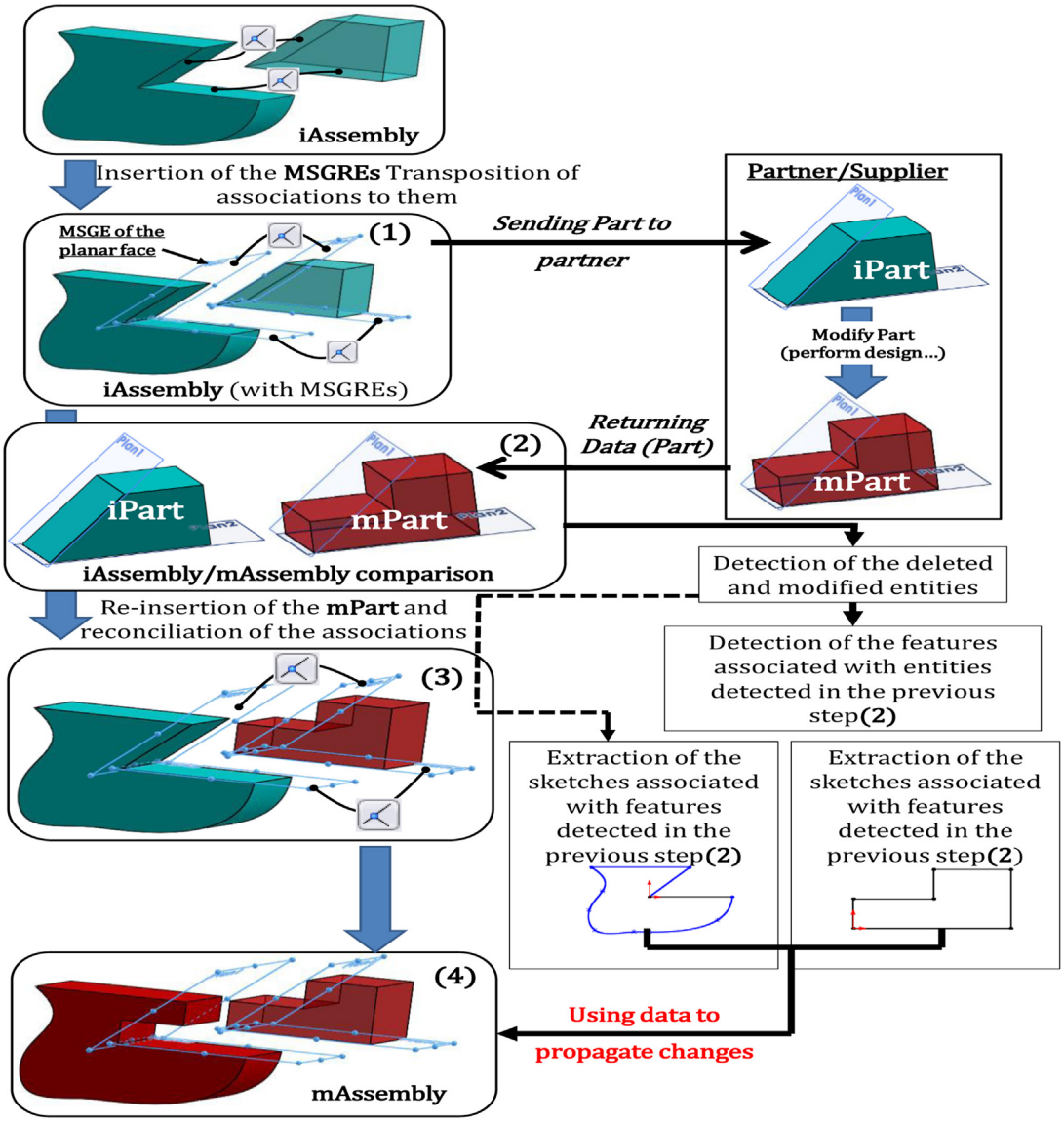

Fig. 1. CAD Assembly Mates Management Model (CAD-A3 M).