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Implementation of persistent identification of topological entities based on macro-parametrics approach

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Abstract

In history based parametric CAD modeling systems, persistent identification of the topological entities after design modification is mandatory to keep the design intent by recording model creation history and modification history. Persistent identification of geometric and topological entities is necessary in the product design phase as well as in the re-evaluation stage. For the identification, entities should be named first according to the methodology which will be applicable for all the entities unconditionally. After successive feature operations on a part body, topology based persistent identification mechanism generates ambiguity problem that usually stems from topology splitting and topology merging. Solving the ambiguity problem needs a complex method which is a combination of topology and geometry. Topology is used to assign the basic name to the entities. And geometry is used for the ambiguity solving between the entities. In the macro parametrics approach of iCAD lab of KAIST a topology based persistent identification mechanism is applied which will solve the ambiguity problem arising from topology splitting and also in case of topology merging. Here, a method is proposed where no geometry comparison is necessary for topology merging. The present research is focused on the enhancement of the persistent identification schema for the support of ambiguity problem especially of topology splitting problem and topology merging problem. It also focused on basic naming of pattern features.

Keywords: Feature based CAD; Macro-parametrics approach; Persistent identification; TransCAD; Topological element

1. Introduction

Computer aided design (CAD) system can be broadly classified into a solid modeling system (B-rep, CSG, etc.) and feature based parametric modeling systems. In case of B-Rep models (boundary representation model) or CSG models (constructive solid geometry models), features, parameters and attributes could not be modified once they are created. On the other hand, parametric modeling system allows the designer to modify the parameters, features and attributes based on product manufacturing information depending on design requirements. Parametric modelers record the history of the design sequentially so that design intent could be satisfied. This feature favors their popularity among commercial design of product models for the use of collaborative design. Procedural models have the advantage of easy editing of dimensional modification. Collaborative CAD design demands the integration between heterogeneous CAD systems for exchanging CAD data model. For CAD system integration, CAD files are exchanged by using standard file formats (direct translation) or XML based neutral macro file (translation using neutral format mechanism) which retains the design intent.

In case of direct translation design data could be lost with great reduction in file size. Design intent, which means product

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creation and modification history, should not be altered in successful CAD data translation. History based macro-parametric approach solves these issues by using XML format neutral macro file. Both these cases of collaborative design should have conformed between the topological and geometrical entities referenced by a feature between the original model and re-evaluated model. Once a design model is modified, topological entities lost their identity. This problem should be solved for successful CAD data translation by achieving persistent identification of all the referenced entities every time after they are modified. This problem is commonly known as persistent identification problem. The mechanism of persistent identification offers, attaching names to topological entities once they are created based on the operations of creation and retrieving of those topological entities between original and modified model every time after the modification occurs.

Macro-parametric approach is a history based parametric method that enables the designer to exchange the parametric information of CAD models which includes product creation history and modification history. The set of standard modeling commands is defined and used in the format of an XML format neutral macro file.

In history based parametric CAD modeling systems, structure of topological entities should be identified consistently; it means entity naming and entity retrieval should be generic of all the topological entities, independent of all CAD systems and unambiguous to identify persistently. If persistent identification is not generic, it could not be applicable to all types of topological entities associated with different features. If the mechanism is dependent on CAD systems, the mechanism will be different for each type of CAD systems (topology based CAD system/geometry based CAD system). In that case, integration between heterogeneous CAD systems is not possible. And the naming rule should be unambiguous to retrieve once the CAD model is gone through topology splitting and topology merging case, when two or more topological entities have the same basic name. And persistent identification should be done with the minimum data required for CAD model translation; that is feature type, attributes of a feature, parameters of a feature, local coordinates of a feature. Naming can be divided into basic naming and ambiguity solving part. Basic naming involves attaching names with features and topological entities associated with that feature (face, edge, vertices). But in different cases, topological entities could have same basic name; which is defined as ambiguity problem. The ambiguity could arise from topology merging or topology splitting case, while modifying the CAD model. It can also happen during the creation stage of the CAD model. For solving these issues, name matching should be conducted between homogeneous CAD systems (name matching) or heterogeneous CAD systems. Name matching involves two different ways. Local matching between topological entities (1: N comparison) or global matching between topological entities (N: N comparison). Local matching comparison one entity from evaluating model with all the referenced entity is pre-edit model; whereas global matching tries to compare all the topological entities of post-edit model with all the topological entities of the pre-edit model (Fig. 1).

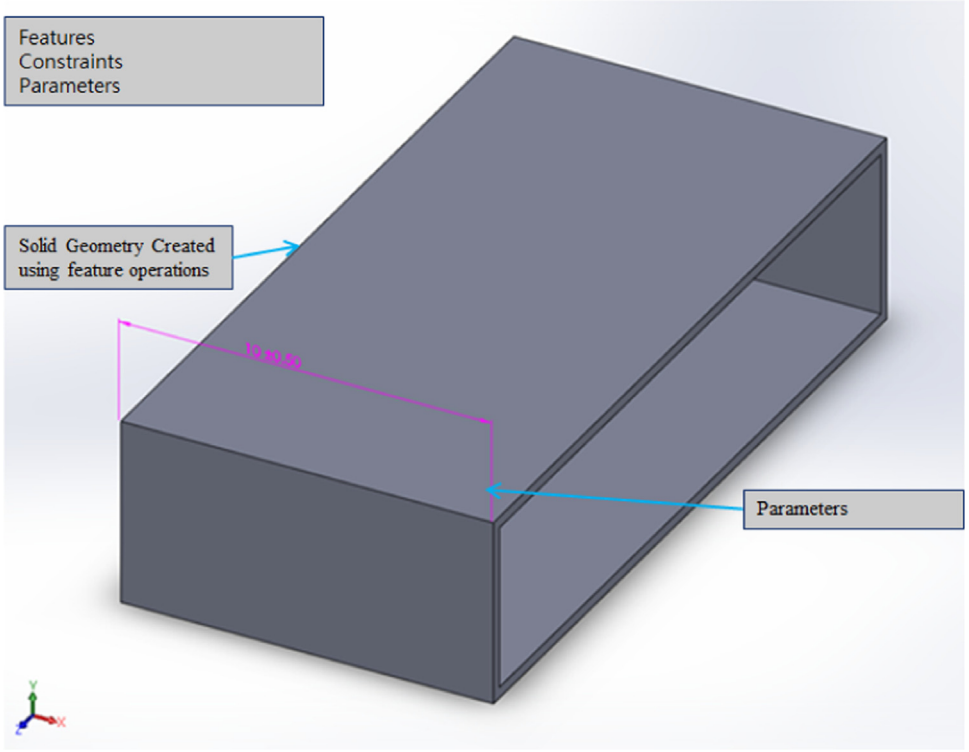

Fig. 1. Components of parametric feature-based solid models.