Paper:

Human Intent Description in Environment Adaptive Product Model Objects

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This paper discusses a method for intelligent computer modeling of engineering objects by extended application of advanced effective entities as features for intent of engineers, behavior of modeled objects, and adaptivities. These and other descriptions are organized in engineering process oriented environment adaptive model objects. Knowledge is defined for engineering activities by using intent of humans. Model objects apply embedded, integrated, and referred knowledge representations according to the source and nature of design intent. Behaviors of the modeled engineering objects are simulated for typical sets of circumstances called as situations. Results of a simulation are evaluated then applied at adaptive actions by the model objects. In this way, a solution has been established for human intent driven control of decision assistance. This paper starts with an introduction of a multilevel modeling in which knowledge represents human intent. Following this, process of modeling by human intent as well as essential approaches for creation and application of design intent description in decision making are outlined. Next, application of integrated and environment adaptive model object is proposed and a four leveled modeling by behavior and associativity features is explained. Finally, selected issues for implementation of the proposed modeling in CAD/CAM environments are concluded.

Keywords: product modeling, description of human intent, behavior based modeling, adaptive description of model objects, design intent based knowledge

1. Introduction

Product design, analysis, and manufacturing planning utilize recent advances in engineering modeling. In present model based product design, engineer defines entities and applies simple rules for calculation of entity parameter values. This modeling of engineering objects does not support description of information about thinking process of engineers and origin of decisions. Consequently, when a model is communicated to and used by remote software for its development, modification, and application in downstream of the engineering process, information is not available for background, motivation, and procedure of decisions. Present style of engineering is characterized by engineers at remote workstations, high number of product variants, and quick decisions on frequent modification of the modeled engineering objects. There is a definite demand for saving information about design intent. In other words, engineers at applications of models would like to know background of decisions and allowed extent of changes by specified intent of the original decision makers.

Recently, analysis of engineering objects by model based simulation provides information about predicted behaviors of modeled objects. These analyses could utilize human related information because they are highly relied on earlier experience of engineers. On the other side, behaviors are expected to be in accordance with intent of multiple humans. Consequently, decision and behavior related information are best originated as design intent.

As a contribution to enhanced decisions during modeling, the authors introduced the aspect of design intent in intelligent engineering modeling. They proposed a modeling that uses environment adaptive model objects utilizing recent advances in modeling as integration of modeling activities, definition of associativities and adaptivities, behavior based analysis and extended application of knowledge. The proposed objects include and apply design intent originated knowledge. Intent of humans responsible for various decisions during engineering activities is described. Intent description carries information about source and content of intent. The modeling proposed by the authors facilitates intelligent modification of models of engineering objects by using of an integrated modeling of engineering objects, design intent, knowledge, and behaviors.

In the proposed adaptive modeling, change of any information within a model and its associative environment initiates changes of the related model objects and their environment to achieve a new and more appropriate description of the modeled objects in new circumstances. The changed information may be about product design, production environment and conditions, financial conditions, customer demand, intent of engineers, knowledge, and experience. While performance analysis of modeled objects often suggests changed design intent, development

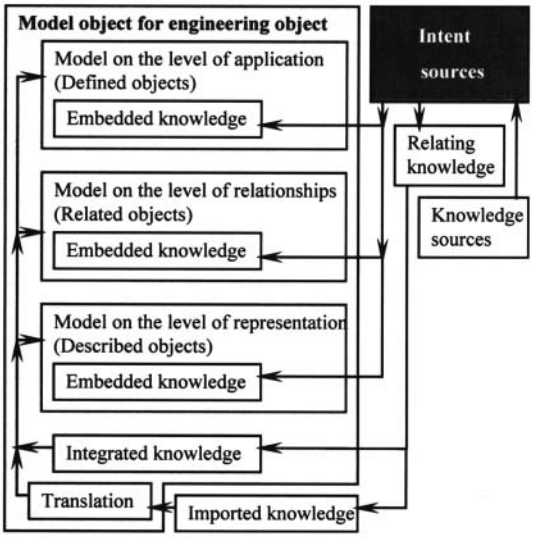

Fig. 1. A multilevel approach to knowledge based modeling.

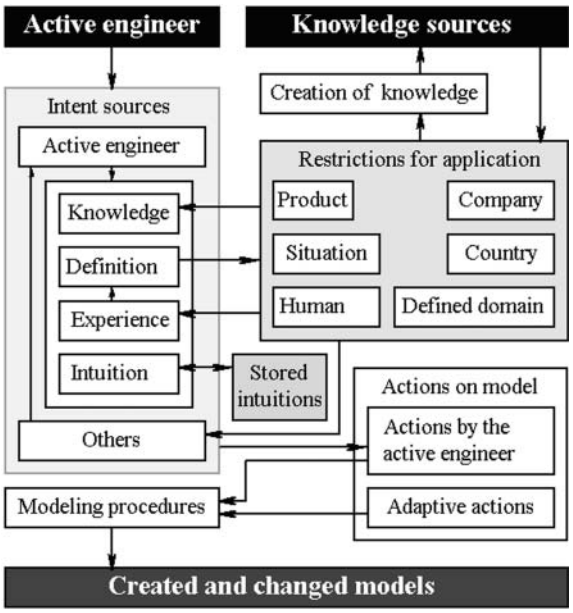

Fig. 2. Process of modeling by human intent.

and modification of modeled objects for changed circumstances often break original intents or find them as incorrect ones.

This paper starts with an introduction of a multilevel modeling in which knowledge represents human intent. Following this, process of modeling by human intent and essential approaches for creation and application of design intent description in decision making are outlined. Next, application of integrated and environment adaptive model objects is proposed and a four leveled modeling by behavior and associativity features is explained. Finally, selected issues for implementation of the proposed modeling in CAD/CAM environments are concluded.

2. Multilevel Modeling by Human Intent Based Knowledge

During product development, engineer creates models of engineering objects as parts, assemblies, etc. To do this, engineer applies input specification, own knowledge and knowledge from the environment of engineering activities. In the meantime, these factors develop an intent in the brain of the engineer. The authors concluded that interdependence of knowledge and human intent is considered as an important issue. They call their approach to solve this problem as human intent driven knowledge based engineering. Intents of humans are added to a model object from the creation of its first entity in it to end of its life. Sources of intents are participants of an actual project, all other engineers involved in concepts, methods, knowledge, and information applied at modeling in that project, experts included in the project from outside, and high number of effects on the project from outside as standards, legislation, etc.

Both modeling of engineering objects and handling of knowledge are conceptualized in three leveled schema (**Fig.1**). Creation of model of an engineering object is done on the levels of defined, related and described objects. In other words, computer description of the model can be decided only for defined and related objects. New or existing objects are related. Knowledge handling is done on the levels of embedded, integrated and imported knowledge. The authors concluded that all of tree techniques are to be applied. Certain elements of knowledge cannot be separated, while others are not allowed to integrate, neither locally or remotely. This structure also facilitates implementation of the proposed modeling as an upgrade of existing modeling in CAD/CAM systems. Imported elements of knowledge may require translation before application.

The authors proposed application of well-proved methods on all levels of modeling. On the application level, entities for definition of modeled objects as features and their attributes are created [1]. On the level of relationships, associativities are defined amongst model entities and their attributes [2]. Associativity can be defined as a simple relation, a rule to calculate some attribute values, a taxonomy, etc. On the level representation, best appropriate descriptions are established for entities and their relationship in compliance with foreseeable applications of the model [3].

Intuitions are described and stored to later retrieve and use. Intuitive intents are identified by circumstances so that they support analysis of behaviors. Content of design intent, structure of intent description, and integration of intent model in product model are considered as the authors conceptualized them in [4].