Knowledge-based Design Environment for primary shaped Micro Parts

ALBERT ALBERS AND JOCHEN A. MARZ

Institute of Machine Design and Automotive Engineering
Product Development Management and Methodology
University of Karlsruhe, P. O. Box 6980, Karlsruhe, Germany
marz@mkl.uni-karlsruhe.de, ++49 721 608 8063, ++49 721 608 6051

Abstract

The present contribution describes a knowledge-based design environment predominantly concentrating on the production-relevant design of primary shaped micro parts. Therein, a computer-aided knowledge base is linked with a design system (CAD system). Compared to a thorough knowledge-based design in means of modelling a part by a rule-based connection of distinct basic objects respectively features, which equals more programming than designing, the prototype exposed promotes the conventional practical design experience. The designed part is subsequently checked on the basis of parameters derived from the part's geometry. Deviations in the design in terms of the production technologies are detected and corrected automatically.

1. Introduction

Production technologies still remain as a central discipline of the product development process for micro parts. Specific parameters and characteristics of the production process define the potential for miniaturization and the realizable qualities of the products. In future, an increasing penetration of the market for industrially fabricated complex micro parts and systems in middle- and high-scale series are predictable. For an effective and production-relevant part design there exists the desire for a knowledge-based support for the designer.
By means of a knowledge-based design environment information and technological specifications of different disciplines – like micro machining of mold inserts or powder injection molding – can be collected and be interpreted from the designer's point of view. The acquired know-how is formulated in design manuals which are systematically stored in a data base. A home made program detects geometric properties of the current draft and compares those to the design manuals. The entire system is implemented in the familiar working environment of the designer (CAD).

2. Geometrical approach

The geometrical approach utilized to verify whether the part can be fabricated by a certain production technology is based on the boundary representation method – B-rep [2]. This approach is found on the part's surfaces and edges.

Looking at the designed part the analysis through the program is classified in to main steps. In the first one, all boundaries have to be selected from the data base of the CAD system and listed consecutively:
1) all solids within the part
2) entire faces and edges of the solids
In the second step, the geometrical interconnections of the boundary elements are determined. Therefore, geometrical information from the data base of the CAD system e.g. the normal vector helps the detect the positions of and angels between single elements.
Along with the designer's input whether the design draft regards the mold insert or the molded and sintered part the information is brought together with the knowledge of the design manual data base. A new level of 'elementary rules' is constituted able to be processed by an appropriate Knowledge-Based Engineering (KBE) module of a CAD system.

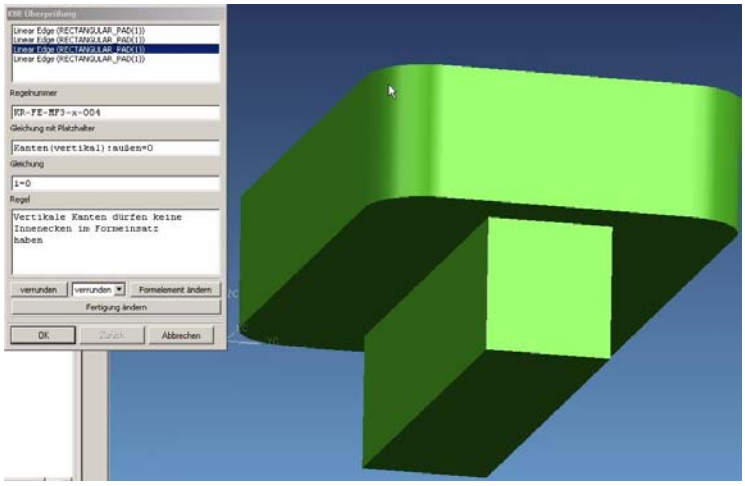

FIGURE 1. Window showing the detected rules which are not adhered

3. Results and Conclusions

Based on the boundary representation method a knowledge-based design environment for primary shaped micro parts was developed. With the help of a home made program the boundary elements and their interconnections could be separated and compared to design know-how derived from demands and restrictions of the production technologies. FIGURE 1 shows one window of the implemented functionalities within a commercial CAD system having a KBE-module. After the automatic correction of the part in FIGURE 1 the lower structure will also have rounded edges similar to the existing edges in the upper part structure.

4. Literature

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