A knowledge-based engineering system for assembly sequence planning

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Abstract

In this study, we developed a knowledge-based engineering (KBE) system to assist engineers in promptly predicting a near-optimal assembly sequence. A three-stage assembly optimization approach with some heuristic working rules was employed to establish the proposed system. In the first stage, Above Graph and a transforming rule were used to create a correct explosion graph of the assembly models. In the second stage, a three-level relational model graph, with geometric constraints and assembly precedence diagrams (APDs), was generated to create a completely relational model graph, an incidence matrix, and a feasible assembly sequence. In the third stage, a robust back-propagation neural network (BPNN) engine was developed and embedded in the Siemens NX system. System users can easily access the volume, weight, and feature number through the Siemens NX system interface, input the related parameters such as contact relationship number and total penalty value, and predict a feasible assembly sequence via a robust engine. Three real-world examples were used to evaluate the feasibility of the KBE system. The results show that the proposed system can facilitate feasible assembly sequences and allow designers to recognize contact relationships, assembly difficulties, and assembly constraints of three-dimensional components in a virtual environment type.

Keyword：Knowledge-based engineering ‧ assembly optimization ‧ assembly sequence ‧ BPNN.