An Enhanced Graph and Artifical Intelligence-based Approach for Assembly Sequence Planning

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Abstract

Research in assembly planning can be categorised into three types of approach: graph-based, knowledge-based and artificial intelligence approaches. The main drawbacks of the above approaches are as follows: the first is time-consuming; in the second approach it is difficult to find the optimal solution; and the third approach requires a high computing efficiency. To tackle these problems, this study develops a novel integrated approach with some graph-based heuristic working rules and neural networks-based practices to assist the assembly engineers in generating and predicting a best and most effective assembly sequence. In the first stage, the Above Graph and transforming rules are used to create a correct explosion graph of the assembly models. In the second stage, a three-level relational model, with geometric constraints and assembly precedence diagrams (APDs), is generated to create a complete relational model graph, an incidence matrix and a globally optimal assembly sequence. In the third stage, the Knowledge Fusion (KF) programming language and back-propagation neural network (BPNN) engine are employed to validate the available assembly sequences. Two real-world examples are utilised to evaluate the feasibility of the proposed model in terms of the differences in assembly sequences. The results show that the proposed model can promptly generate feasible assembly sequences, facilitates assembly sequence optimisation and allows the designers to recognise the contact relationship and assembly constraints of three-dimensional (3D) components in a virtual environment type.

Keyword：Keywords: assembly sequence planning, Above Graph, assembly precedence diagrams, back-propagation neural network