Applying Multi-Objective Evaluation to Automated Assembly Planning in Early CAD Design Stage Title

By Weifeng Huang

Candidate for Ph.D. in Mechanical Engineering

Major Professor: Dr. Christopher Hoyle

Abstract

Successfully predicting an accurate estimated cost is important in the assembly planning process. When designing an assembly plan, an accurate estimation ensures that the proposed plan can be achieved within the predetermined budget. However, achieving an accurate prediction is a challenge since it requires professional judgment, which is dependent upon the previous experiences of those conducting the estimation. As the scale of the production process increases, making correct estimations for each step in a process is difficult. Although many design tools have been developed to shorten the design process, the focus has shifted to achieving *automated assembly planning* with large scale CAD models in the early design stage. Traditional design tools are less suitable for this task because they require a significant amount of human interaction, and are not very adaptable to 3D CAD models. This PhD dissertation introduces a new *automated design tool* that can help a designer estimate assembly time and stability for assembly planning process, to support cost estimation and increase the efficiency of the product (or system) design. The first step of this research is to conduct experiments for assembly time and stability evaluation, and this field data is used for model development and validation. Second, a machine learning method is applied to predict the assembly time based on the tessellated model; the results indicate high accuracy compared to the traditional design for assembly (DFA) time estimation method. Third, two novel approaches, a theory-based and a physics-based approach, are created to evaluate assembly stability during the assembly process. Finally, a multi-objective evaluation function that includes assembly time, stability, and predicted uncertainty is applied to the automated assembly planning process. With the implemented tool, engineers can easily evaluate assembly plans that can accommodate actual production environments with lower cost.

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