A Graph-based Model for Understanding Interlocking Assemblies

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Generating a feasible disassembling sequence for a mechanical assembly is a fundamental research topic in geometric reasoning. Its inverse problem, where creating feasible geometry with respect to predefined constraints on the order of assembly, attracts great attentions in computer graphics community. Specifically, the interlocking assemblies that all component parts have to be disassembled after a key part, also have a long history in the design of puzzles, furniture, architecture, and other complex geometric structures. Though many design tools that allow creating interlocking assemblies has been recently contributed, the interlocking mechanism has not yet been understood which prevents exploring the full searching space as well as restricts their applicability for design.

In this report, we propose a graph-based model for describing the interlocking mechanism. The core idea is to represent part relationships with a family of base *Directional Blocking Graphs (DBGs)*. With the help of classic graph theory, our approach build a connection between the connectivity of DBGs and its corresponding assembly's interlocking property. As a result, our model could be useful for start-of-art interlocking design with more design flexibility.

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1 INTRODUCTION

Assemblies are almost everywhere around us. The furniture, cars and even buildings could be considered as assemblies. Given an assembly, analyzing its structural stability, tolerance accumulation and assembling sequences are classic problems, which are also indispensable for validation before manufacture. To find a feasible solution, designers have to switch between design and analysis for many iterations. Most of practical assembly designs require great amount of heuristic knowledge, which prevent non-professional users from participating. Instead, researchers in computer graphics begin to consider a new type of constrains-aware design, where constraints are satisfied during the design stage while providing users with a relatively large design space.

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