Automated Rapid Manufacturing Feedback for Design Considering Advanced Joining Processes

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Abstract

As manufacturing advancements continue to develop, designers must be able to consider these technologies during the design process. Unfortunately, many of these new technologies such as additive and advanced joining have many nuances that require expert knowledge to effectively apply. Additionally, new design techniques such as topology optimization allow users to create geometries that aren't traditionally manufacturable. The approach presented in this thesis bridges the gap of expert knowledge between design and new advanced manufacturing technique, specifically linear friction welding. The first step of the approach analyzes a part geometry agnostically to determine the unmachinable regions. This is done by converting a tessellated shape input into a voxel solid and analyzing different linear toolpath approach directions that could occur. Areas that the toolpath cannot access are left which isolate regions of unmachinable solids. The solids are then used to determine areas were pre-joining machining could occur, taking advantage of the capabilities of linear friction welding. This is done using a decomposition method based on Massoni's work while using a two-objective search optimizing for total cost of manufacturing and total unmachinable volume. Manufacturing plans are created by applying cutting planes and evaluated by two objectives. Ability to manufacture the original input geometry and cost of total manufacturing plan. Results of the work demonstrate the ability to determine manufacturing plans and the potential tradeoffs of complex geometries, processing, and costs.

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