AI DECOMPOSITION OF COMPLEX PARTS FOR MANUFACTURING WITH ADVANCED JOINING PROCESSES

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Abstract

Recent advancements in joining operations and additive manufacturing now allow complex metal parts to be built up from raw materials, as opposed to being machined down from solid blocks. This not only opens up the design space, but also allows for much more efficient manufacturing. By decomposing a complex part into simpler subparts, material waste and machining time can be reduced. This can significantly lower the production cost. However, if decomposed into too many pieces, the cost of the additional required processing steps will outweigh these savings. The primary challenge in designing with advanced joining is in deciding how to divide complex parts into subparts to be cost effective and feasible. It can be difficult to intuitively decide how to split up a part, and currently it requires hours of an engineer's time to make comparisons between different combinations of stock materials and joining operations. The approach presented in this dissertation employs various optimization algorithms to develop an artificial intelligence (AI), which can find and generate advanced joining manufacturing plans at the level of human experts. In addition, since closed-die forging is a common solution for metal aerospace parts, an automated closed-die forging design method is presented. This approach allows engineers to compare traditional and new manufacturing methods to make better manufacturing decisions early in the design phase.

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