EVALUATION OF COMPUTATIONALLY OPTIMIZED DESIGN VARIANTS FOR ADDITIVE MANUFACTURING USING A FUZZY MCDM APPROACH

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Abstract

The industry needs generic methods for selecting design variants obtained from the computational tools of Design for Additive Manufacturing (DfAM). Therefore, a decision support system based on quantitative metrics for selecting a design variant is needed to overcome the current industry's barriers to using the unique capabilities of the additive manufacturing process. This study attempts to define multiple criteria for evaluating the design variations under opportunistic and constraint-based design for additive manufacturing. The Multi-Criteria Decision-Making (MCDM) aggregates four different metrics representing the geometric complexity, cost-benefit, and additional cost due to support structure. A fuzzy power Maclaurin symmetric mean operator is employed for the aggregation of metrics for evaluating the design variant for manufacturing in Metal Additive Manufacturing (MAM) using Laser Powder Bed Fusion Process (L-PBF). The efficacy of the proposed approach is exemplified by evaluating the topologically optimized design variants of an airplane bearing bracket and an engine bracket. Ranking and selection of the design variants using the proposed approach resulted in a 50% cost reduction in the case of an airplane bracket and a 75% cost reduction in the case of an engine bracket compared with the original design manufactured in AM.