Computational Redesign for Remanufacturing and Repurposing

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Abstract

This paper explores the potential of topology optimization techniques in achieving sustainable manufacturing practices. We focus on the redesign of existing components for alternative applications and manufacturing challenges that might arise from redesigning. Topology optimization, a computational method for optimizing material distribution within a given design space, offers a systematic approach to reducing material usage while maintaining structural integrity and performance. However, its potential to redesign a component for remanufacturing is an underexplored area. Through a case study, this paper highlights the iterative process of topology optimization in redesigning components for remanufacturing. It explores how existing components can be reimagined and optimized for different applications, extending their lifecycle and maximizing resource efficiency.

This paper specifically focuses on challenging aspects such as remanufacturing constraints and reachable design domain for which precision production methods could provide meaningful contributions. The results show that Ignoring these aspects undermines the sustainability objectives of remanufacturing as a result of increased processing steps, material waste, and energy consumption. In conclusion, this paper highlights the necessity of integrating considerations of manufacturing constraints and reachable design domains into the re-design process of for sustainable remanufacturing.