Topology optimization and 3D printing of a lightweight protective robotic vehicle structure

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The goal of this project is to design and 3D print a lightweight protective structure of a robotic vehicle structure. Lightweight structure design is a prevalent technology considered by aerospace and automotive engineers that carries challenges associated with protection capabilities under impact. The design problem to be addressed is the optimal structural layout that preserves the mechanical integrity of the structure subjected to external loading using the minimum amount of material. Our work addresses this problem using three-dimensional structural topology optimization. The use of topology optimization allows the designer to synthesize a concept structure by distributing a given amount of material within a volume, referred to as the design domain. The design domain does not include any predetermined structural feature, allowing topology optimization synthesizing innovative, non-conversional designs. In our work, the concept structural design is refined using computer-aided design tools and 3D printed. The final 3D printed component is tested and assembled to the robotic device. This technology involving three-dimensional topology optimization and 3D printing can be applied to the design of innovative structures in micromechanical applications and extended to the aerospace and automotive industries.

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