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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations (IP)

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THE DESIGN OF A LIGHTWEIGHT ROBOTIC ARM LINK USING FUNCTIONALLY GRADED MATERIALS: A CASE STUDY

Abstract

To date, work on light weight robot arm design has focused on the actuators and drive trains - comparatively little work has been done on robotic arm links. As such, this paper discusses the development and design of a lightweight robotic arm link for supporting and manipulating a vision system. The evolution of ideas using topological optimisation (TO) and functionally graded materials (FGMs) towards the lightweight design are shown and reviewed. Since the final design uses TO, additive manufacture (AM) is needed in its manufacture. This puts a constraint on the materials available - 11 commercially-proven materials were tested. These range from low density polymers to high density nickel alloys. Materials are grouped to ensure that physical binding between the two FGM constituents is possible. All combinations of materials within each group were tested. To create the FGM-TO parts, a combination of user-developed ABAQUS scripts and Tosca Structure TO software was used. Geometric constraints were put in place during the mass-focused TO to ensure the part could be physically manufactured. The key contribution of this work is the blending of materials while ensuring manufacturability of lightweight parts. The final design reduces the mass compared to the original arm link by 61.4%.