Paper ID: 39973
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications and Rapid Prototyping (9)

Author: Mr. Thomas McMaster
University of Strathclyde, Glasgow, United Kingdom, thomas.mcmaster@strath.ac.uk

Prof. Xiu-Tian Yan
University of Strathclyde, United Kingdom, x.yan@strath.ac.uk

A METHODOLOGY FOR DESIGN OF LIGHTWEIGHT PARTS IN HARSH ENVIRONMENTS

Abstract

A methodology for the creation of functionally graded material (FGM) parts in harsh environments has been developed. It uses a two-stage multi-objective optimisation approach that focuses first on the task-dependent material choice and then on the topological optimisation (TO) of the part. Constraints are in place to ensure the part can be manufactured, including the extent/smoothness of material blending and the minimum feature size and layer thickness. Thought is also put into space-specific concerns, such as radiation and cyclic thermal heating. The methodology assumes an initial design solution has already been generated, and covers from the beginning of the CAD phase to the end of the computational testing phase, and includes materials dispensing and mixing processes for FGM, material layout strategies and the impact of the thermal gradient on cooling and performance. Design constraints are created with additive manufacture (AM) in mind, and suggestions are made for manufacturability, such as the scanning strategies and surface finish. The methodology is tested on two example parts to show it's effectiveness.