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Adaptive mesh decomposition strategies for topology optimization for multi-functional additive manufacture

David Brackett, Ajit Panesar, Adeji Aremu, Ian Ashcroft*, Ricky Wildman, Richard Hague

Faculty of Engineering, University Park, The University of Nottingham, NG7 2RD, UK
*ian.ashcroft@nottingham.ac.uk

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This work investigates the use of hierarchical decomposition adaptive meshing strategies for topology optimization using a bi-directional evolutionary structural optimization (BESO) algorithm. The proposed method uses a dual mesh system which decouples the design variables (background mesh) from the finite element mesh (foreground mesh). The investigation focuses on previously unexplored areas of these techniques to investigate the effect of five meshing parameters on the analysis solving time and the analysis quality. The foreground mesh parameters investigated were varied independently across solid and void domain regions, specifically adjacency ratios and minimum and maximum element sizes. Within the topology optimization iterative progression, strategies for controlling the parameters were investigated, specifically fixed and incremental variation. Significantly improved efficiencies were found compared to using a uniform mesh. Application of this technique to multi-functional additive manufacture is then considered where the topology optimization is combined with functional component placement and routing.