Editorial

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Topology optimisation is the most flexible and leading-edge structural optimisation technology because it allows topological changes as well as shape changes in target structures. It also can provide useful designs for high-performance structures that implement new structure functions. Over the past few decades, the use of relevant practical methods has been confirmed as the most promising techniques for achieving least-weight and performance-driven designs for actual engineering structures in different industries. Recently, design problems with greater complexity have now become a hot topic, especially when the additive manufacturing (AM) techniques enable the realisation of those sophisticated topological designs. Solving more sophisticated engineering design problems that include multi-disciplinary objectives, complex multi-material structure, multi-scale systems based on current manufacturing technologies and advanced structural

analysis techniques involve new breakthroughs. Thus, a variety of topology optimisation methods and their accompanying technical schemes have been proposed to deal with such problems, so as to obtain more effective solutions. This special issue is organised by three guest editors who focus on the topic of structural topology optimisation. There are seven papers accepted after a critical peer review process. We summarise the accepted papers in this special issue as follows:

In the context of metamaterial design, a multi-objective topology optimisation method for the design of lattice structures with the negative Poisson's ratio has been developed by Du et al. to improve the structural load-bearing and energy absorption characteristics. In term of multi-material design, Xu et al. propose a topology optimisation framework for multiple materials to design periodic structures using BESO method. The optimised periodic structures are easy for manufacturing and assembling. In addition, topology optimisation design under uncertainty has attracted more and more attention. Li et al. study the topology optimisation of truss structures under stochastic seismic excitations, where the nodal displacement variance and the stress variance are taken as the constraints. Moreover, a robust topology optimisation method for laminated composite plate under interval random hybrid uncertainties is proposed by Wu et al., where the imprecise probability of the uncertain material properties and ply orientations is considered. The hybrid perturbation technique is proposed to estimate the 'worst-case' in the propagation of the uncertainty. Wang et al. have explored the concurrent design of both the macro- and micro-structure to fully leverage the state of art of the AM. To address the connectivity issue between the graded micro-structures, a dynamic optimisation design approach of graded lattice structures based on a postprocessing scheme is developed. The numerical examples demonstrate that the graded microstructures can connect smoothly with the neighbouring cells after the postprocessing. Meanwhile, a multiscale concurrent optimisation method is presented by Yu et al. for the simultaneous design of the structural configurations and layouts of cellular structures, in which the connectivity of a family of graded microstructures is guaranteed via reconstructing the level set function (LSF) and parallelly moving the cutting plane. Finally, Zhao et al. present a validation process for an automotive subframe stiffener plate with innovated design obtained from topology optimisation, where the modal analysis of both the numerical simulations and experimental measurements are presented. There still exists good scope for further extension on these conducted studies, such as the combination with AM as well as artificial intelligence (AI), multi-physics design including the flow and heat transfer problems, development of accelerated topology optimisation algorithm, application of topology optimised metamaterials, and so on. They will bring new challenges and great application prospects.

In brief, our special issue has received research articles from different aspects in the field of topology optimisation, which reflects the up-to-date progress in this field. We express our warm gratitude and thanks to Professor M.A. Dorgham and the editorial team and all contributing authors, reviewers, and our assistants for their efforts that have made this special issue a unique success. We believe that this special issue will be a valuable contribution to topology optimisation literature and open new frontiers for the researchers.

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