Dynamic Topology Optimization of Structure under Random Excitations

Bin Xu, professor
School of Mechanics, Civil Engineering and Architecture, Northwestern Polytechnical University, Xi'an, 710072, P. R. China

Abstract: The structures in aerospace engineering are developing toward the characteristics of precise and lightening, and subjected to increasingly harsh vibration environments. Traditional structural designs involving dynamics mainly focus on stiffness issues such as displacement and compliance of structures under dynamic loads, while structural designs that emphasize strength are relatively rare. This seriously hinders the engineering application of structural topology optimization methods in aerospace and other fields. To address the issue of strength requirements in lightweight structural design for engineering applications, the topology optimization methods for typical structures considering dynamic stress requirements under random excitations are studied in this work. 1) A methodology for maximizing dynamic stress response reliability of continuum structures involving multi-phase materials is established; 2) A methodology for the topology optimization of continuum structures subject to dynamic stress response constraints under random excitations is proposed; 3) A new layout optimization method is proposed to consider high-cycle dynamic fatigue constraints which are caused by periodic random dynamic loads.