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整体式柔性机构的多目标可靠性拓扑优化设计

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摘要 在用多目标连续体拓扑优化方法设计整体式柔性机构时，将材料弹性模量和外载荷视为随机变量，因而作为目标函数的机构应变能和交互势能亦为随机变量．采用一次二阶矩可靠性理论中的Hasofer-Lind和Rackwitz-Fiessler方法，推导了应变能与交互势能双模式串联时的系统失效概率的迭代计算公式，建立了一个整体式柔性机构多目标可靠性拓扑优化设计对偶数学模型，采用序列凸规划理论中的对偶算法进行优化求解．以反向器柔性机构设计作为仿真算例，结果表明，随着可靠性约束指标的增大，拓扑优化设计结果趋向保守．

关键词 柔性机构 连续体 多目标 拓扑优化

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Reliable multi-objective topology optimization design of the monolithic compliant mechanism

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Abstract

In the process of designing the monolithic compliant mechanism via multi-objective topology optimization of continuum, the elasticity modulus and external loads are treated as random variables, and so are the strain energy and the mutual potential energy acting as the objective function. The Hasofer-Lind and Rackwitz-Fiessler method is adopted to derive the iterative formulations on the failure probability of a series system consisting of two failure modes, the strain energy and the mutual potential energy. The dual mathematical model of reliable multi-objective topology optimization design of the monolithic compliant mechanism is built. The dual arithmetic of sequential convex rogramming is adopted as the solving strategy. An inverter compliant mechanism is adopted as the numerical example and indicates that the topology optimization design result approaches conservativeness with an increasing reliability constraint index.

Key words compliant mechanisms continuum multi-objective topology optimization

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