冲击载荷下磁流变变刚度变阻尼缓冲系统减振控制 Absorbing Control of Magneto-rheological Variable Stiffness and Damping System under Impact Load

董小闵 余淼 廖昌荣 陈伟民

重庆大学

关键词： 磁流变液 半主动控制 变刚度 冲击载荷

摘 要： 针对传统缓冲着陆装置阻尼刚度不可调节的局限性，提出采用基于磁流变技术的自适应变阻尼变刚度缓冲装置。首先从理论上研究了采用磁流变阻尼器实现刚度阻尼等效控制的原理，分析了刚度阻尼调节范围；进而设计了基于能量守恒原理和天棚阻尼控制技术的飞行器缓冲着陆的自适应控制器，最后通过数值分析考察缓冲器和控制策略的有效性。分析结果表明，与被动缓冲装置相比，基于磁流变技术的缓冲装置不仅能降低着陆冲击过程的峰值载荷，而且需要的行程也较小，表明设计的缓冲装置和控制策略是有效的。 To overcome the limitation of traditional absorber systems with invariable damping and stiffness characteristics which can only achieve good absorbing performance under designed conditions, a new absorber based on two magneto-rheological (MR) dampers was proposed to realize the variable damping and stiffness characteristics. As the first step, the theory of variable damping and stiffness characteristics of the proposed absorber was analyzed, and the adjustable range of variable damping and stiffness was also analyzed. Then an adaptive controller based on the energy principle and skyhook control was developed. Finally, a numerical simulation was performed to validate the proposed absorber and the controller. The simulations show that the absorbing system based on the MR absorber could greatly reduce the peak impact load of sprung mass with smaller stroke of absorbing system. Moreover, it has better performance than passive absorbing system, which shows that the absorber based on MR variable stiffness and damping is feasible in practice.

查看全文（请使用Adobe Acrobat 6.0版本浏览） 返回首页 引用本文