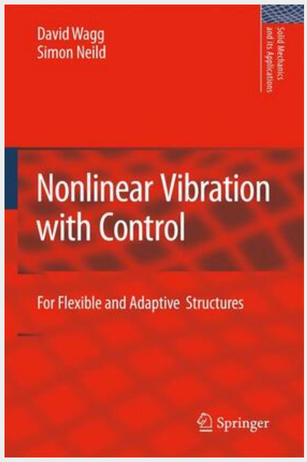
Wagg / Neild

Nonlinear Vibration with Control

For Flexible and Adaptive Structures



Identifying, modelling and controlling nonlinear vibrations is becoming incre- ingly important in a range of engineering applications. This is particularly true in the design of ?exible structures such as aircraft, satellites, bridges, sports stadia and other tall/slender structures. There are also applications in the areas of robotics, mechatronics,micro-electro-mechanicalsystems(MEMS),andnon-destructivete- ing (NDT) and related disciplines such as structural health monitoring (SHM). In the majority of cases, the trend is towards lighter structures, increased ?exib- ity and other higher levels of performance requirements. It is increasingly common for structuresto have integratedactuator andsensor networks to carry out tasks such as limiting unwanted vibrations, detecting damage and in some cases changing the shape of the structure. These types of structures have become knownas smart str- tures (sometimes called adaptive or intelligent structures). They are often made of new compositematerials and their ability to performmultiple tasks means that these types of smart structures are multifunctional. Nonlinearbehaviourin structuraldynamics arises naturallyfrom a rangeof c- mon material and geometric nonlinearities. By their nature, these structures are t- ically made up of highly ?exible continuous elements such as beams, cables and plates. They are also required to operate in a dynamic environment and, as a result, understanding the vibration behaviour of the structures is critically important.

This book covers the basic principles of nonlinear vibrations which occur in flexible and/or adaptive structures, with an emphasis on engineering analysis and relevant control techniques. Understanding nonlinear vibrations is becoming increasingly important in a range of engineering applications. This is particularly true in the design of flexible structures such as aircraft, satellites, bridges, and sports stadia. There is an increasing trend towards lighter structures, with increased slenderness, often made of new composite materials and requiring some form of deployment and/or active vibration control. There are also applications in the areas of robotics, mechatronics, micro electrical mechanical systems, non-destructive testing and related disciplines such as structural health monitoring. Two broader themes cut across these application areas: (i) vibration suppression -- or active damping -- and, (ii) adaptive structures and machines. The aim of this book is to provide a comprehensive discussion of nonlinear multi-modal structural vibration problems, and then to show how vibration suppression can be applied to such systems by considering a sample set of relevant control techniques. The rationale is to produce a volume which is accessible to practitioners in the application areas, as well as students and researchers working on related topics. In particular, the aim is to introduce the key concepts of nonlinear vibration to readers who have an understanding of linear vibration and/or linear control, but no specialist knowledge in nonlinear dynamics or nonlinear control.

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