Preface

Structural health monitoring (SHM) has emerged as an important research area in recent years because of its strong links with structural safety and the need to monitor and extend the lives of existing structures. SHM is an interdisciplinary field, combining elements of mechanics with those of information science and sensors and actuators. The practical importance of SHM is clear from the continuing failures which affect engineering structures such as bridges, aircraft, helicopters, and nuclear reactors. In many cases, a health monitoring system installed on the structure can detect and isolate the damage before it becomes catastrophic, thereby reducing the likelihood of failures. SHM systems can therefore reduce costs and save lives.

A key problem in SHM involves performing damage detection and isolation from a set of measured data. Typically, the measured data is contaminated with noise, and the number of measurements is limited. In model-based SHM, a mathematical model is used to develop simulated measured data for the damaged structure. Then, the simulated data is used to develop a pattern recognition approach which maps the damage location and size to the simulated data. Algorithms such as neural networks are often used to perform this pattern recognition task. However, neural networks tend to be black boxes which are difficult to understand. In this book, an alternative and powerful architecture, the genetic fuzzy system (GFS), is demonstrated for beams, composite tubes, and helicopter rotor blade health monitoring. A novel feature of this book is the focus on helicopter rotor health monitoring, as this represents a system of considerable complexity.

The fuzzy logic approaches addresses uncertainty directly through the linguistic fuzzifier and is very well suited to SHM because it gives linguistic outputs which can be used to guide prognostic action. The use of the genetic algorithm automates the development of the fuzzy system and makes the method easy to use for problems involving a large number of measurements and damage location sizes, which is typical of SHM. By demonstrating the use of the GFS as a series of progressively complicated structures, this book enables the reader to learn about this new and powerful approach to SHM. The book also provides some MATLAB code for the algorithms developed. This book will be useful for aerospace, civil, and mechanical engineers working in the area of SHM. It will also be useful for computer scientists and applied mathematicians interested in the application of GFSs to engineering problems.

Bangalore, India

Prashant M. Pawar
Ranjan Ganguli

http://www.springer.com/978-0-85729-906-2

Structural Health Monitoring Using Genetic Fuzzy Systems
Pawar, P.M.; Ganguli, R.
2011, VIII, 132 p., Hardcover
ISBN: 978-0-85729-906-2