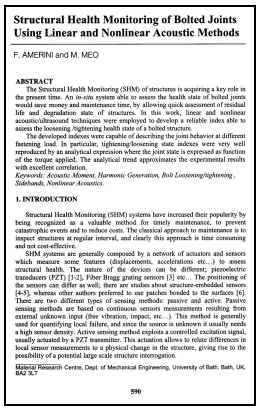

Structural Health Monitoring of Bolted Joints Using Linear and Nonlinear Acoustic Methods

F. AMERINI and M. MEO

ABSTRACT

The Structural Health Monitoring (SHM) of structures is acquiring a key role in the present time. An *in-situ* system able to assess the health state of bolted joints would save money and maintenance time, by allowing quick assessment of residual life and degradation state of structures. In this work, linear and nonlinear acoustic/ultrasound techniques were employed to develop a reliable index able to assess the loosening /tightening health state of a bolted structure.

The developed indexes were capable of describing the joint behavior at different fastening load. In particular, tightening/loosening state indexes were very well reproduced by an analytical expression where the joint state is expressed as function of the torque applied. The analytical trend approximates the experimental results with excellent correlation.

Keywords: Acoustic Moment, Harmonic Generation, Bolt Loosening/tightening , Sidebands, Nonlinear Acoustics.

1. INTRODUCTION

Structural Health Monitoring (SHM) systems have increased their popularity by being recognized as a valuable method for timely maintenance, to prevent catastrophic events and to reduce costs. The classical approach to maintenance is to inspect structures at regular interval, and clearly this approach is time consuming and not cost-effective.

SHM systems are generally composed by a network of actuators and sensors which measure some features (displacements, accelerations etc...) to assess structural health. The nature of the devices can be different; piezoelectric transducers (PZT) [1-2], Fiber Bragg grating sensors [3] etc... The positioning of the sensors can differ as well; there are studies about structure-embedded sensors [4-5], whereas other authors preferred to use patches bonded to the surfaces [6]. There are two different types of sensing methods: passive and active. Passive sensing methods are based on continuous sensors measurements resulting from external unknown input (free vibration, impact, etc...). This method is generally used for quantifying local failure, and since the source is unknown it usually needs a high sensor density. Active sensing method exploits a controlled excitation signal, usually actuated by a PZT transmitter. This actuation allows to relate differences in local sensor measurements to a physical change in the structure, giving rise to the possibility of a potential large scale structure interrogation.

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Ключевые слова:

Содержание.