Contribution to new solutions of instrumentation of Civil Structures for continuous dynamic monitoring
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C. Moutinho[*] and A. Cunha[*]

[*] CONSTRUCT - ViBest, Faculty of Engineering (FEUP), University of Porto
R. Dr. Roberto Frias S/N, 4200-465 Porto
e-mail: moutinho@fe.up.pt; acunha@fe.up.pt, web page: http://www www.fe.up.pt/vibest

ABSTRACT

The continuous dynamic monitoring of structures is an area that has lately assumed great importance in Civil Engineering. The main reason is related to the subject of Operational Modal Analysis (OMA), which aims to identify the modal parameters of a structure in operating conditions (particularly with regard to natural frequencies, damping ratios and mode shapes) taking into account the measured ambient vibrations at critical points.

In these cases, the measurement of vibrations is performed without disturbing the normal functioning of the structures, which may be implemented in buildings, bridges (railway, roadway, highway), dams and offshore structures. Given the importance of this subject, the Laboratory of Vibrations and Structural Monitoring FEUP (ViBest) has carried out consistent work in this area, both in the development of numerical tools for identifying modal parameters and in the continuous measurement of vibrations in actual structures (see www.fe.up.pt/vibest).

Parallel to this area, ViBest has also developed and implemented vibration measurement techniques that enable to solve specific problems of current systems and to evolve toward a new generation of measurement systems. In particular, the difficulties that are to be overcome include: a) excessive cost of traditional measurement systems; b) excessive dependence on external power supply; c) frequent failures in data acquisition attributed to heavy operating systems; d) difficulty in being physically integrated into structures, taking up too much space and being barely manageable, and; e) when using cables, the number of sensors is limited due to the exponential complexity of the acquisition system;

In contrast, data acquisition systems based microcontrollers and MEM sensors offers the following advantages: a) cost attractive; b) enable wireless solutions; c) autonomous and small size (easily integrated into structures); d) possibility of installation of high number of sensors; e) low power consumption (can run on batteries or solar panels); f) simplicity of functioning and robustness; g) low maintenance, and; h) may be easily customized.

In this context, this paper intends to divulge the instrumentation solutions that have been used by ViBest in the continuous dynamic monitoring of some structures using this technology. The architecture of the developed sensors is described, as well as the power solutions used to guarantee long periods of measurement. In order to illustrate the efficacy of these solutions, a few practical examples of monitoring large-span bridges are presented.