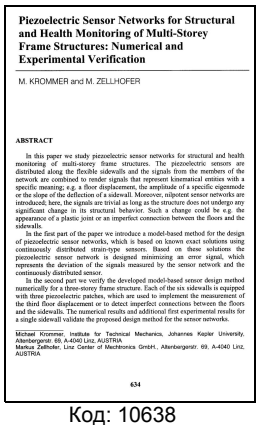

Piezoelectric Sensor Networks for Structural and Health Monitoring of Multi-Storey Frame Structures: Numerical and Experimental Verification

M. KROMMER and M. ZELLHOFER

ABSTRACT

In this paper we study piezoelectric sensor networks for structural and health monitoring of multi-storey frame structures. The piezoelectric sensors are distributed along the flexible sidewalls and the signals from the members of the network are combined to render signals that represent kinematical entities with a specific meaning; e.g. a floor displacement, the amplitude of a specific eigenmode or the slope of the deflection of a sidewall. Moreover, nilpotent sensor networks are introduced; here, the signals are trivial as long as the structure does not undergo any significant change in its structural behavior. Such a change could be e.g. the appearance of a plastic joint or an imperfect connection between the floors and the sidewalls.

In the first part of the paper we introduce a model-based method for the design of piezoelectric sensor networks, which is based on known exact solutions using continuously distributed strain-type sensors. Based on these solutions the piezoelectric sensor network is designed minimizing an error signal, which represents the deviation of the signals measured by the sensor network and the continuously distributed sensor.

In the second part we verify the developed model-based sensor design method numerically for a three-storey frame structure. Each of the six sidewalls is equipped with three piezoelectric patches, which are used to implement the measurement of the third floor displacement or to detect imperfect connections between the floors and the sidewalls. The numerical results and additional first experimental results for a single sidewall validate the proposed design method for the sensor networks.

Michael Krommer, Institute for Technical Mechanics, Johannes Kepler University, Altenbergerstr. 69, A-4040 Linz, AUSTRIA
Markus Zellhofer, Linz Center of Mechtronics GmbH., Altenbergerstr. 69, A-4040 Linz, AUSTRIA

Код: 10638

M. Krommer, M. Zellhofer

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Ключевые слова:

Содержание.