Workshop on Engineering Optimization 2019

Book of Abstracts

Editors:

Bartłomiej Błachowski, Piotr Tauzowski

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Optimization of Sensor Placement Using Continuous Approaches

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The present study provides a comprehensive framework for sensor layout optimization aiming at accurate estimation of the modal coordinates coming from the structural response. The proposed procedure consists of two steps briefly described below.

The first step is a selection of vibrational modes taking part in the motion of structures during their normal operation – in this case subjected to traveling load. Among these structures there are various types of bridges especially railway bridges. In the case of present study structural responses are obtained from rigorous finite element (FE) model of the bridge. The FE model is calibrated with measured response of real bridge located in Huta Zawadzka. The calibration process is based on the displacement signals of the bridge under the traveling load.

In the second step modes of interest are selected and a set of candidate sensor locations is proposed. It is a subset of all degrees of freedom (DOFs) of the FE model from which several locations are chosen as best possible locations for the displacement sensors. The above sensor placement problem is a combinatorial task. Many methods for solving such problems have been developed previously, but in the case of large scale structures they require tremendous computational effort. To reduce this effort the so-called *convex relaxation* is incorporated into optimization process. The technique consists in reformulation of combinatorial problem into continuous convex one [1]. Then, the convex relaxation is achieved by introducing the so-called *sensor density function,* which assigns a certain metric for individual candidate sensor location [2]. Next, the value of this function is optimized in such a way that it maximize determinant of the Fisher Information Matrix. It has been shown that above algorithm is very effective and is distributing a number of sensors in several iterations only.

Finally, it is worth noting that presented method can be used to distribute sensors for structural health monitoring [3]. Moreover, it can be also applied in modal control strategies in vibration suppression [4].

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