

Soft-computing algorithms for adaptive vibration control

Abstract

Uncontrolled vibration pose a threat, regardless of the structure it affects. Appearance of uncontrolled vibration lowers the comfort of structure's use, increases deterioration of the structure and may, in some cases, result in its destruction endangering human life and causing significant financial losses. These risks can be addressed by active vibration control systems. This strategy is straightforward in cases, when controlled object is invariant and its model is known. Unfortunately, in many practical cases of structures' exploitation these conditions are not fulfilled. Complex structures with multiple degrees of freedom are hard for identification. What is more, their parameters often change in time, which is caused by influence of environment, operational parameters, variable object's configuration and so on (e.g. bridge parameters dependent to variable traffic). In such situations classical, well-established control solutions are of limited use. The issue may be solved with use of the so-called soft computing methods, that include e.g. artificial neural networks, evolutionary approaches, fuzzy inference and many more. In recent years many solutions in this area were reported, many of which not yet verified in vibration control.

The aim of the project is to extend author's method of autonomous choice of ANN ensemble to selected problems of vibration control. The method will be supported by the state-of-the-art methods in adaptive vibration control and incorporated in neuro-fuzzy system that chooses optimal strategy out of multiple solutions. The structure of the proposed system will be optimized with use of the error backpropagation algorithm.

The method will be evaluated in large-scale experimental programme including typical civil-engineering structures. Experiments will involve both numerical simulations and series of practical experiments on configurable test stand designed to mimic selected civil engineering structures. The stand will be designed and assembled in scope of the project.

Method planned for development in project will significantly contribute to the area of adaptive control – through new, versatile solutions that have not been used yet in this scope. What is more, method will also enable large efficiency increase for currently used adaptive vibration control systems.