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Rozprawa doktorska
pt.

MODELOWANIE I BADANIE JEDNOWYMIAROWYCH DRGAJĄCYCH UKŁADÓW MECHATRONICZNYCH

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Gliwice 2011

MODELLING AND TESTING OF ONE-DIMENSIONAL VIBRATING MECHATRONIC SYSTEMS

ABSTRACT

The thesis presents the issues of modelling and testing of flexural vibrating mechatronic systems with piezoelectric transducers used as actuators or vibration dampers. The method of analysis of the considered systems was presented, started from development of the mathematical model, by setting its characteristics, to determine the influence of the system's properties on these characteristics.

The discussed subject is important due to increasing number of applications, both simple and reverse piezoelectric phenomena in various modern technical devices. The process of modelling of technical devices with piezoelectric materials is complex and requires large amounts of time because of the complexity of the phenomena occurring in these systems. The correct description of a given system by its mathematical model during the design phase is a fundamental condition for proper operation of the designed system. Therefore, in the work the processes of modelling, testing and verification of used mathematical models of one-dimensional vibrating mechatronic systems were presented. A series of discrete – continuous and continuous – continuous mathematical models with different simplifying assumptions was created. Using the created models and corrected approximate Galerkin method the characteristics of the considered systems were designated. The analysis of an influence of geometrical and material parameters of system's components on obtained characteristics was conducted, including a glue layer between the piezoelectric transducer and a mechanical subsystem. To generalize, the obtained results were presented in a dimensionless form. A mathematical model that provides the most accurate analysis of the system together with maximum simplification of used mathematical tools and minimize required amount of time was indicated.

The identification of the optimal mathematical model that meets the assumed criteria is the main purpose of this thesis, which is an introduction to the task of synthesis of one-dimensional vibrating continuous systems.