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# DEVELOPING OF A SHAKING TABLE CONTROL ALGORITHM

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## ABSTRACT

This study deals with a shaking table control algorithm for modelling seismic ground motions for testing of structures. During development of the control algorithm the following requirements were considered: limitation in the platform maximum displacement, dynamic characteristics of the shaking table actuators and of the tested structure.

In order to create the shaking table control algorithm, the following software package was developed: an algorithm for transmission of the seismic record under the restriction of the maximum allowed platform displacement; a program for interactive planning of the test and creating a numerical model of the actuator; a program for simulation of the tested structure under seismic loading and a program for forming a control signal to the shaking table control system.

The first packege is based on signals perturbation and fitting technique [1]. It includes piecewise linear approximation and smoothening of the signal. Selecting the smoothening parameters is an adaptive procedure, which is performed by comparing the spectrum characteristics of the original and reproduced signals. It is shown that the proposed algorithm is a very effective tool for reproduction of real earthquakes by using shaking tables with limited platform displacements.

The actuators' model is obtained based on tests of their response to a given dynamic loading using a system identification algorithm [2]. The second program minimizes the number of required tests, considering the given accuracy of the actuators' approximating model. A quadratic criterion for deviation minimization is used for planning the tests and obtaining the parameters of the actuators' model [3].

A method for fast simulation of seismically-excited active controlled structures [4] has been used for the third programm realisation. The method is based on exact time discretization of the controlled system. It enables to obtain the parameters of the descretized model, which are calculated only once, before the simulation of the structural seismic behavior. As a result, the load applied by the structure on the shaking table is obtained.

The control signal is formed according to the frequency spectrum of the ground motion and its time history. The program forming the signal works in parallel to the first one, considering the limitations in the platform maximum displacements. The reproduced

(artificial) ground motion is applied to a numerical model of the tested system, including the structure, the shaking table actuators and the response of the structure is compared to that under a real ground motion.

## REFERENCES


[1] G. Agranovich, Y. Ribakov and B. Blostotsky, "Improved Shaking Table Control Algorithms for Testing of Earthquake Excited Structures", *The International Conference on Modern Trends in Structural Engineering for Seismic Design*, Ariel, Israel, October 8-11, 2007.

[2] G. Agranovich, A. Levitsky, B. Blostotsky and Y. Ribakov, "Application of Pole-Assignment Method to Design and Verification of AMD Dampers Based on Shaking Table Simulation", *The International Conference on Modern Trends in Structural Engineering for Seismic Design*, Ariel, Israel, October 8-11, 2007.

[3] W. L. Brogan, "*Modern Control Theory*", 3-ed edition, Printice Hall, 1991.

[4] G. Agranovich, Y. Ribakov and B. Blostotsky "A Method for Fast Simulation of Seismically-Excited Active Controlled MDOF Structures", *Journal of Structural Control and Health Monitoring*, vol. 11, pp. 369-378, 2004.