

Modeling and Parameter Identification of Vibrations of a Double Torsion Pendulum with Friction

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Abstract: The purpose of this paper is to investigate a double torsion pendulum with planar frictional contact. The single torsion pendulum with one-degree-of-freedom is an angular equivalent of the linear harmonic oscillator. The second degree of freedom has been obtained by adding a free body to the inverted single torsion pendulum. The free body's angular displacement is caused by frictional forces appearing in the interface (contact zone) between the free body and the pendulum column's head kinematically excited at its base by a mechanism with torsion spiral spring. An experimental station has been set up and run to find most unknown parameters of the pendulum from the time series of state variables taken as inputs to the Nelder-Mead method of identification. The obtained results proved significant usability of the identification method in the case of numerical simulation of the pendulum's dynamical model. It has not been satisfactorily proved in the case of time characteristics coming from a real system that exhibits also some unrecognized physical effects.

Keywords: friction, planar contact, numerical modeling, double torsion pendulum, parameter identification, nonlinear vibrations, kinematic excitation, kinematic forcing mechanism, Nelder-Mead method