ORAL presentation

AMPLITUDE RESONANT JUMPS IN TRANSIENT REGIMES OF COMPLEX STRUCTURE OSCILLATION

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This paper presents interesting phenomena of transient resonant jumps in the transversal oscillations of the coupled deformable bodies systems. The representative systems encapsulate plates, membranes or belts coupled with a layer of continuously distributed discreet elements with a visco-elastic nonlinear rolling properties [1]. The structural models consists by a set of two coupled non-homogenous partial non-linear differential equations [2]. The problems to solve are divided into space and time domains by classical Bernoulli-Fourier method. In the time domains, the systems of coupled ordinary non-linear differential equations are completely analog for different systems of deformable bodies and are solved by using the Krilov-Bogolyubov-Mitropolskiy asymptotic method [3]. First asymptotic approximation of the solution for amplitude and phase difference of coupled time modes in every Eigen mode of small transversal oscillation of bodies was obtained. These solutions were further numerically solved in Mathematica ODE solver for analysis of amplitude and phase jumps in the resonant transition regimes, appearance of the newborn instable branches and main curve shifting after transition. The form of the solution was also suitable for discussion on amplitude jumps responses to the rate of changes of the external excitation frequencies. Sudden unexpected amplitude jumps [1-4], often undesirable in mechanical constructions dynamics can be controlled and driven by appropriate choice of external excitation frequency but also with carefully designed properties and parameters of system. Highly adaptive biological systems likewise could be controlled also by appropriate magnitude and frequency of external excitation, but in these systems, unexpected jumps are considered as benefits tending to alert system on change and trigger regular activity. Knowing how to recognize and cope with these phenomena is of evitable importance in both, live and mechanical, systems.

Keywords: multi-bodies system, visco-elastic nonlinear rolling coupling elements, mode interactions, multi-frequency regimes, transient resonant jumps.

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Refrerences

1. Simonović J., (2015), *Influence of rolling visco-elastic coupling on non-linear dynamics of double plates system,* Iranian Journal of Science and Technology, Transactions of Mechanical Engineering, ref. No. 1271,vol. 39 M1+ , pp 163-173, April 2015.
2. Hedrih (Stevanović) K R. and Simonović J., (2015), *Structural analogies on systems of deformable bodies coupled with non-linear layers,* Int. J. Non-Linear Mech, Vol. 73, July 2015, Pages 18–24.
3. Mitropolyskiy Yu. A., (1995), *Nelinyeynaya mehanika-Asimptoticcheskie metodi,* (Non-linear Mechanics-Asymptotic methods), Institut matematiki NAN Ukraini, Kiev, pp. 397.
4. Kozmin A., Mikhlin Yu., Pierre C., (2008), Transient in a two-DOF nonlinear systems. *Nonlinear Dynamics*, Vol. 51, Numbers 1-2, pp.141–154.