15th INTERNATIONAL CONFERENCE
Dynamical Systems — Theory and Applications
December 2-5, 2019. Lodz, POLAND.

DSTA 2019

paper id: MTR317

Using electromagnetic springs for tailoring dynamical characteristics

Maksymilian Bednarek, Donat Lewandowski, Jan Awrejcewicz

Abstract: The article presents a theoretical analysis of the characteristics of magnetic and electromagnetic springs as well as linear and non-linear mechanical springs. Analysis covered both static and dynamic properties. New physical and mathematical models of magnetic springs have been proposed and have been subjected to experimental verification on a specially designed and built experimental stand. The stand consists of an aerostatic guide that has one degree of freedom. Thanks to aerostatic supports, the friction in the system is minimized, damping is limited to viscous, damping resulting from eddy currents in the coil and extortion of the controller. The components of the station are made of non-ferromagnetic materials. The stand allows static and dynamic study of springs and systems with automatic regulation. The article presents a method of changing the characteristics of magnetic springs by controlling the current in the coil. A number of experiments were carried out to determine the characteristics of specific system components and verify the correctness of the proposed mathematical models. A controller has been developed to shape the characteristics of electromagnetic springs. Different algorithms with feedback were used and compared to find the best fit to the desired characteristics. The controller allows us to simulate and reproduce in real spring systems exactly the characteristics we need, for example, non-linear exponential, as well as linear, which is distinctive for mechanical springs.

[1)] Maksymilian Bednarek, M.Sc. (Ph.D. student): Łódź University of Technology, 90-924, Poland (PL), maksimusbed@interia.pl.

[2)] Donat Lewandowski, Associate Professor: Łódź University of Technology, 90-924, Poland (PL), donat.lewandowski@neostrada.pl.

[3)] Jan Awrejcewicz, Professor: Łódź University of Technology, 90-924, Poland (PL), jan.awrejcewicz@p.lodz.pl.