

Presentation 6-July-2023, 10.00-10.30, Room D31

MS Teams <https://teams.live.com/join/9477754188160?p=ifpn7kCM7U1olA1Q>

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"Synchronization in energy harvesting systems with multiple resonators"

Grzegorz Litak

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We study the complex dynamical system composed of bistable neighbor coupled oscillators for energy harvesting. The nonlinear effect was caused by buckling instability. The oscillators are excited inertially by the harmonically moving frame and effected by the additive noise. The mechanical energy of the particular resonators (oscillators) is converted into the electrical power output. The numerical study reports a resonant-like behavior of the total power for certain noise levels of excitation. By using the recurrence statistics and other nonlinear approaches we identify different types of synchronization for increasing noise level. The simulated states show different levels of resonator synchronization which correspond to the power outputs. Consequently we emphasize the importance of synchronization phenomenon for energy harvesting.

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Dr Grzegorz Litak completed his M.Sc. degree in physics at Maria Curie Skłodowska University (UMCS) in Lublin, Poland in 1988. Later, working on the effect of disorder on correlated and exotic superconductors, he received his Ph.D (1994) and D.Sc (2002) degrees from the same University. After defending his Ph.D thesis he moved to Lublin University of Technology where he is presently working as a full professor. From that time he also started his research on nonlinear dynamics. He focused on bifurcation theory, chaotic dynamics and nonlinear time series analysis. Recently, he was also involved in research on mechanical energy harvesting, focusing on frequency broadband effects. While working at the Lublin University of Technology, in 2014, he received the professor title in the field of technical sciences. In 2016-2018 he was also a professor at the AGH University of Science and Technology. G. Litak is an expert on nonlinear and complex phenomena. G. Litak published over 300 papers including about 230 in international journals. He actively collaborates with many researchers from various countries around the world. Presently, he is a member of the Polish Physical Society, European Physical Society, Polish Society of Theoretical and Applied Mechanics and Euromech. Prof. Litak was an organizer and invited speaker of many international conferences. He promoted 4 doctors in the field of mechanics and machine construction. He was also the contractor and manager of many national and international projects.



Presentation 6-July-2023, 10.30-11.00, Room D31

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"Impulse excitation diagram in energy harvesting systems"

Damian Gąska, Jerzy Margielewicz

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Nonlinear energy harvesters, despite their indisputable advantages (broadband work with various input parameters), have a characteristic feature for all nonlinear systems – coexisting solutions may occur in them. For the same excitation conditions, there may be many orbits, some of which will be more energy efficient and others less. Under zero initial conditions, nonlinear energy harvesters usually vibrate at the low-energy orbit, which leads to small energy generation. One of the biggest challenges in this area is to control the orbit so that the system works as efficiently as possible. The presentation focuses on various strategies for jumps between the orbits using impulses. Different impulse characteristics and their sequences for periodic and chaotic zones are analyzed. Therefore, a detailed analysis is presented for many strategies using an impulse excitation diagram (IED) as a numerical tool for accurately estimating the amplitude of the impulse, its duration, and the moment of initiation. The presentation will be based on the results of computer simulations of energy harvesters with elastic elements and will consist of two main parts - analysis of excitation with a mechanical impulse and analysis of excitation with an electrical impulse.



Damian Gąska is a professor at Silesian University of Technology, Faculty of Transport and Aviation Engineering. He deals with non-linear dynamics and issues related to chaos theory. He is the author or co-author of over 70 scientific publications in international journals, 3 monographs and 6 patents. He actively cooperates with an international team of scientists. His main areas of scientific interest are energy harvesting and cranes dynamics. He is a member of the Polish Standardization Committee in the field of cranes safety.



Jerzy Margielewicz is a professor at Silesian University of Technology, Faculty of Transport and Aviation Engineering. He deals with non-linear dynamics and issues related to chaos theory. He is the author or co-author of over 100 scientific publications in international journals, 7 monographs and 5 patents. He actively cooperates with an international team of scientists. His main areas of scientific interest are energy harvesting and, in cooperation with medics, biomechanics of the masticatory system.