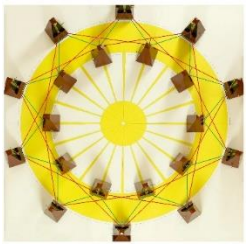
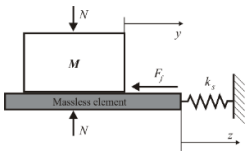
name of the unit:		symbol:
DIVISION OF DYNAMICS Faculty of Mechanical Engineering, Lodz University of Technology		K-13 http://www.kdm.p.lodz.pl
head of the unit:	potential promoters:	contact person:
Prof. Tomasz Kapitaniak, PhD, DSc	Prof. Tomasz Kapitaniak, PhD, DSc, Prof. Przemysław Perlikowski, PhD, DSc, Prof. Andrzej Stefański, PhD, DSc, Piotr Brzeski, PhD, DSc, Artur Dąbrowski, PhD, DSc.	Prof. Tomasz Kapitaniak, PhD, DSc phone: 48- 42-631-22-31 k-13@adm.p.lodz.pl

scope of activities:

The main areas of research interest can be listed as follows:

- investigations on chimera and chimera-like states,
- mitigation of vibrations, probabilistic methods and dynamics of non-smooth systems,
- discontinuous dynamical systems and problems of their control.





present activities:

We study the phenomena of chimera states and related chimer-like states in networks of coupled nonlinear oscillators. The considered models are typically arranged in the form of a ring with local or non-local couplings. We analyse the possibilities of the chimera's occurrence, its properties and transitions between different types of behaviours. The models considered within the studies relate to mechanical systems, artificial flows and complex maps.

Our research is also related to the study of novel tuned mass dampers. We developed various modifications to the classical device. The most successful is one with a particular type of inerter, which incorporates a continuously variable transmission that enables step-less changes of inertance. Thus, it allows to adjust parameters of the damping device to the current forcing characteristic. We also apply probabilistic methods in the analysis of dynamics of dynamical systems.

We develop new method of Lyapunov exponents estimation and work on a novel approach to optimal control of non-smooth dynamical systems. We also model and analyze numerically unidirectionally coupled, identical dynamical systems in various configurations and develop a new friction model that takes into account the so-called mapping effect.

future activities:

The continuation of present activities, the generalization of the results and the description of new phenomena occurring in complex dynamical systems.

publications/patents, awards, projects:

Most relevant publications:

- F. Hellmann, P. Schultz, P. Jaros, R. Levchenko, T. Kapitaniak, J. Kurths, Y. Maistrenko, *Network-induced multistability through lossy coupling and exotic solitary states*, Nature Communications 11, 592 (2020).

- M. Balcerzak, A. Dabrowski, B. Blazejczyk–Okolewska, A. Stefanski, *Determining Lyapunov exponents of non-smooth systems: Perturbation vectors approach*, Mechanical Systems and Signal Processing, 141, 106734 (2020).

- P. Brzeski, A.S.E. Chong, M. Wiercigroch, P. Perlikowski, *Impact adding bifurcation in an autonomous hybrid dynamical model of church bell*, Mechanical Systems and Signal Processing 104, 716 (2018).

We conduct the following research projects:

Solitary states in coupled oscillators (OPUS Programme NCN); *Mitigation of vibrations by tuned mass damper with inerter and non-linear damper* (OPUS Programme NCN); *Multi-frequency quasiperiodic solutions in coupled oscillator systems* (OPUS Programme NCN); *Sample based approach for simultaneous estimation of different stability measures for multistable dynamical systems* (SONATA Programme NCN); *Chimera and chimera-like states in networks of coupled oscillators with moving support* (SONATA Programme NCN); *Simple numerical method of constrained control optimization for discontinuous systems based on Fourier series* (PRELUDIUM Programme NCN).

Awards and scholarships:

Award for scientific achievements contributing to the development of science for young scientists from the Polish Academy of Sciences (P. Perlikowski, P. Brzeski, D. Dudkowski); *The scholarship for young scientists from the Minister of Science and High Education* (P. Perlikowski, P. Brzeski, D. Dudkowski); *Award from the Prime Minister of Poland for scientific activity: best PhD Thesis in 2017* (P. Jaros, P. Brzeski); *START scholarship from Foundation for Polish Science* (P. Perlikowski, P. Brzeski, P. Jaros, D. Dudkowski).

keywords:

chimera states, multistability, hidden attractors, synchronization, complex systems, bifurcations, chaos, mitigation of mechanical vibrations, non-smooth systems, fry friction, multiscale modelling, Lapunov exponents, optimal control

list of internship proposal in this research team:

Analysis of dynamical behaviours in various types of complex systems with possible applications.