

Project title:

**NONLINEAR DYNAMICS OF THERMALLY AND MECHANICALLY
LOADED COMPOSITE STRUCTURES**

Project duration: 1 February, 2023 to 31 December, 2025

Funding: The project is supported by the Inter-Academy Agreements on Scientific Cooperation of the Serbian Academy of Sciences and Arts and the Bulgarian Academy of Sciences.

PARTNER INSTITUTIONS:

From Bulgaria:

- Bulgarian Academy of Sciences, Institute of Mechanics, Sofia, Bulgaria.

From Serbia:

- Serbian Academy of Sciences and Arts, Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia;
- University Union-Nikola Tesla, Belgrade, Serbia.

BULGARIAN PRINCIPAL INVESTIGATOR:

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SERBIAN PRINCIPAL INVESTIGATOR:

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PROJECT DESCRIPTION:

New trends in theoretical and applied mechanics demand comprehensive research of different coupled problems. Increasing requirements for energy efficiency and reliability, new materials, and new requirements introduced by the industry's digitalization and development of new industrial branches define new coupled problems and topics within different research disciplines of mechanics. In many modern, high technological areas, such as microelectronics (MEMS, sensors, actuators, etc.), the chemical industry, nuclear energetic technologies, the aerospace industry, etc., thermoelastic problems are crucial for the design and proper technological operation of complex systems and structures.

The thermoelastic behavior of structures started to be studied intensively in the last few decades, although it was previously the subject of interest in several published publications. Numerous recent papers present research on the nonlinear behavior of these structures by using methods for nonlinear dynamics analysis, looking for nonlinear periodic, quasi-periodic, or chaotic oscillations.

The tasks and the problems described above will be the main framework for the research cooperation in this project. The keywords of the proposed project are coupled problems, bifurcation analysis, nonlinear thermoelastic vibration, and composite materials.

The main objectives of the proposed research are:

- Developing new mathematical models of vibrating composite structures, including high nonlinearities, such as large deflections, coupled and uncoupled thermo-mechanical and thermo-electromechanical fields, "breathing cracks", delamination, etc.
- Performing the bifurcation analysis of the developed models for nonlinear dynamics systems;
- Developing damping models for the dynamic behaviour of composite structures based on the fractional derivatives;
- Developing new approaches for health monitoring and damage detection, considering temperature influence;
- Experimental and numerical verification of developed models and approaches;
- Developing new mathematical models of bio-composites, especially those containing Gentamicin.

Main expected results (including joint publications, participation at scientific events, international research projects etc.) are presented as follows:

- The main scientific results of this research cooperation will be published as common publications in high-impact international journals;
- The scientists, participants of the proposed project, plan to mutually support each other in supervising PhD thesis in the fields which are the subject of this project;
- A special session or an international workshop for discussion and presentations of the state-of-the-art results in the investigated fields will be organized;
- Presentations will be organized during the project realization within the active seminars in the Mathematical Institute SANU, as well as in the Institute of Mechanics of BAS, in order to introduce the scientific society to the content of project results;
- New international cooperation teams will be formed for preparing international projects applications.