

HETEROGENEOUS STRUCTURE DYNAMICS

Founded in 1943.

Head of the research group: **Vladimir Vasilyevich SMOGUNOV**, Doctor of Engineering Sciences, Professor, Honoured Worker of Higher Education.

Initially, the group was based on the research group in mechanics at Odessa Industrial Institute, which was relocated to Penza in 1943. Being part of Penza Industrial Institute, the research group was further developed by mechanical engineers who served as Heads of the Department of Theoretical Mechanics at various times, namely Boris Meyrovich Abramov (Head of the Department from 1 October 1943 to 18 August 1947); Kozma Mironovich Gustin, PhD in Engineering, Associate Professor (Head of the Department from 1 September 1947 to 7 March 1957); Konstantin Ivanovich Kostin, PhD in Engineering, Associate Professor (Head of the Department from 7 March 1957 to 26 August 1957); Bronislav Frantsevich Vilyum, PhD in Physics and Mathematics, PhD in Engineering, Associate Professor (Head of the Department from 26 August 1957 to 17 September 1971); Gedal Ovseevich Yaroshevich, PhD in Engineering, Associate Professor (Head of the Department from 1 September 1971 to 1 September 1975); Aleksey Aleksandrovich Rostov, PhD in Engineering, Associate Professor (Head of the Department from 17 September 1976 to 1 September 1981); **Nikolay Ivanovich Gordienko**, Doctor of Engineering Sciences, Professor (Head of the Department from 1 September 1981, to 1 October 1996).

In 1992, **V. V. Smogunov**, Doctor of Engineering Sciences, Professor, Head of the Department from 1 October 1996 to 1 October 2014, restructured the research group into what is now a unit of theoretical mechanics, receiving the title *Heterogeneous Structure Dynamics*. **V. V. Smogunov** was the long-standing head of the group.

Members of the research group: A. N. Alekseev, Doctor of Engineering Sciences, Professor; P. G. Mikhaylov, Doctor of Engineering Sciences, Professor; **A. Yu. Muzyemnek**, Doctor of Engineering Sciences, Professor; **V. G. Nedorezov**, Doctor of Engineering Sciences, Professor; Yu. G. Bochkareva, PhD in Engineering, Associate Professor; O. A. Vdovikina, PhD in Engineering, Associate Professor; M. I. Volnikov, PhD in Engineering, Associate Professor; V. Yu. Zaytsev, PhD in Engineering, Associate Professor; A. V. Nozdrachev, Doctor of Engineering Sciences, Professor; B. A. Filippov, PhD in Engineering, Associate Professor; T. V. Khuraeva PhD in Engineering, Associate Professor; V. A. Shorin, PhD in Engineering, Associate Professor.

The research group's main research areas are internal and external dynamics of heterogeneous structures, dynamics of heterogeneous road structures, and theory of subjective self-organisation of intellect.

The research mainly results in the development of methods for experimental research of heterogeneous structure characteristics, assessment models and criteria for vibration and shock protection of rod heterogeneous structures, structure evolution models, computational and experimental methods for studying multiphase

heterogeneous structures, and methods for studying fluctuations of structures with distributed parameters

The most significant recent research findings include:

- Discovery of a fundamentally new pattern in dissipative heterogeneous structures – a relationship between external friction and acceleration.
- Innovative models for reconstruction and strengthening of roadbeds.
- Identification of road destruction patterns.
- Innovative means for high-rise building rescue operations.

The research outcomes are well represented in self-published compilations, namely *System Analysis, Data Processing, and New Technologies* and *Heterogeneous Structure Dynamics*.

The department has held a university seminar in Heterogeneous Structure Dynamics supervised by **V. V. Smogunov**, Doctor of Engineering Sciences, Professor. The seminar has been attended by representatives from universities, enterprises, and organisations of Penza and other cities, including Moscow, Samara, Saratov, Saransk, Ulyanovsk, Volgograd, Astrakhan, Chelyabinsk, Magnitogorsk, and Perm.

The research group maintains close creative ties with research and educational organisations, including Moscow Automobile and Road Construction State Technical University (MADI), MIREA – Russian Technological University, Moscow Institute of Electronics and Mathematics (MIEM), M. V. Lomonosov Moscow State University, N. P. Ogarev Mordovia State University, Bauman Moscow State Technical University, Saratov Chernyshevsky State University, Ulyanovsk State University, Saint Petersburg Electrotechnical University "LETI", Baltic State Technical University "Voenmeh" named after D. F. Ustinov, Yuri Gagarin State Technical University of Saratov, Magnitogorsk State Technical University, Perm State University, Astrakhan State Technical University, Penza State Technological University, and the Penza University of Architecture and Construction.

The research outcomes in the development of mathematical models for studying the dynamics of spatial heterogeneous structures have been integrated into the training process at the Department of Theoretical and Applied Mechanics and Graphics as computational experiment methods within the *Dynamics* unit of the *Theoretical Mechanics* discipline.

The department's computer centre has served a base for the Interdepartmental Multimedia Laboratory, which functions as a training facility for students from various academic programmes.

The research group has published 148 scientific and methodological papers in heterogeneous structure dynamics, 15 scientific and educational publications, and 122 articles in research journals. The group has received 16 patents.

The research group has supervised 26 PhD dissertations and 5 Doctor of Sciences Dissertations.



■ Group members during the seminar on Models and Methods of Hybrid Intelligence



■ Group members during the seminar on Heterogeneous Structure Dynamics, 2008