Institute for Problems in Mechanical Engineering of the Russian Academy of Sciences

History of Institute

- IPME RAS was founded in 1986 as Leningrad branch of the A. A. Blagonravov Institute of Mechanical Engineering of the USSR Academy of Sciences.

  In 1991 it was transformed into an independent institute.

- Research areas of the Institute are dynamics, strength and reliability of machines and structures including marine, arctic and underwater operating in extreme conditions.

- Main directions of development of the Institute are mechanics, thermodynamics and kinetics of transient processes in nanomaterials and "smart" materials, phase transitions and structural defects, dynamics of vibrational, wave and vibroimpact processes, theory and methods of control processes in complex physical and technical systems, nano- and microtribology.

General information

The total number of employees of the IPME RAS is **236** people, of which

194 research staff,

67 are Doctors of Sciences,

54 are Candidates of Sciences (PhD.)

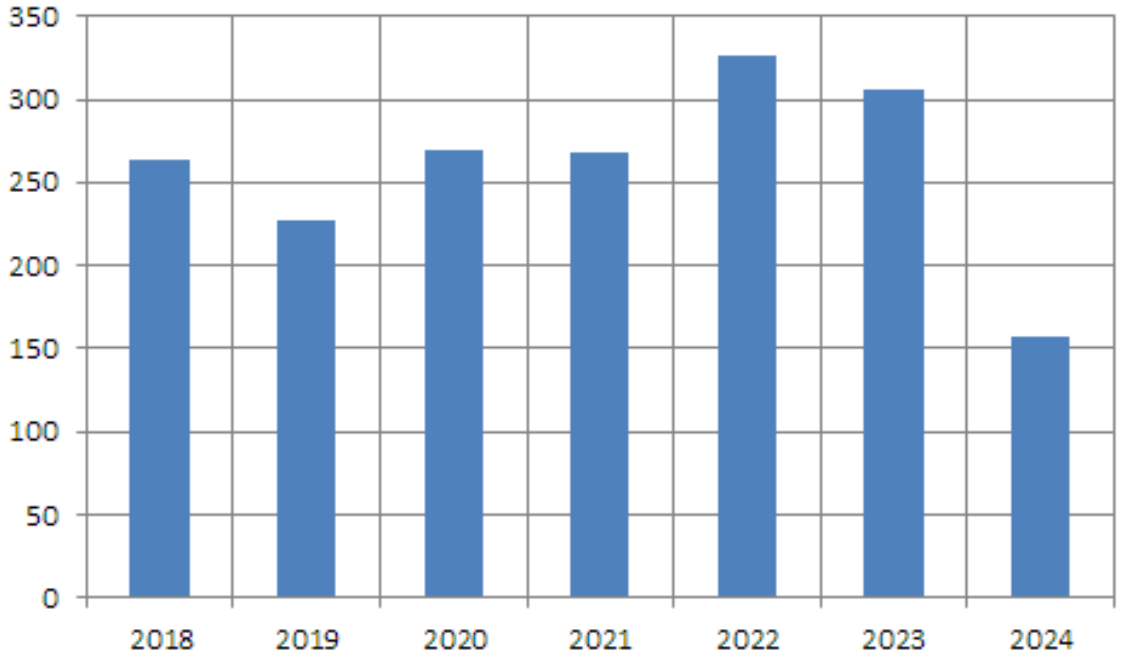
3 doctoral dissertation councils have been opened

4 RAS Academicians and Corresponding Members are employees of the IPME RAS

Publication activity

Over 900 papers are published in scientific journals indexed in databases WoS in last five years

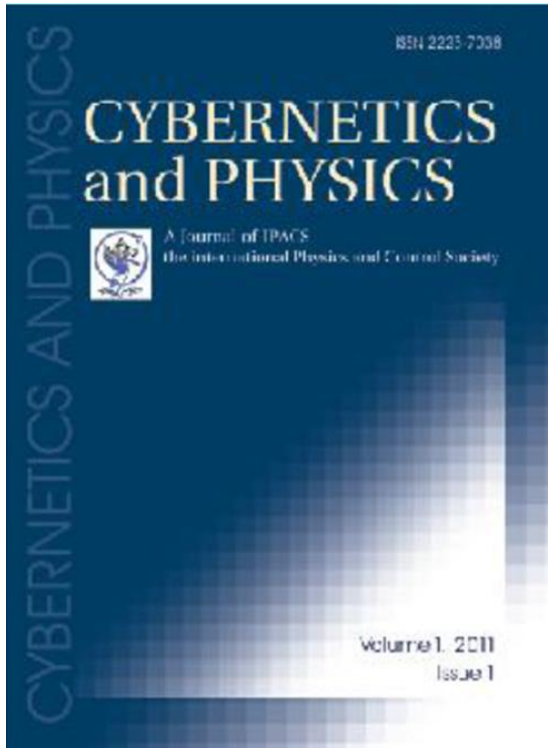
35% of them were published in в Q1, Q2



The Presidential Scholarship for postgraduate students working on Russia's scientific and technological development priorities has concluded. The results of the first competitive selection process have been announced. A total of 4,700 applications were submitted, and 500 winners have been selected. Among the winners are two of our postgraduate students and staff members.

CYBERNETICS AND PHYSICS

Main academic journal of REC AI-CPhS (published by IPME RAS)



CYBERNETICS AND PHYSICS

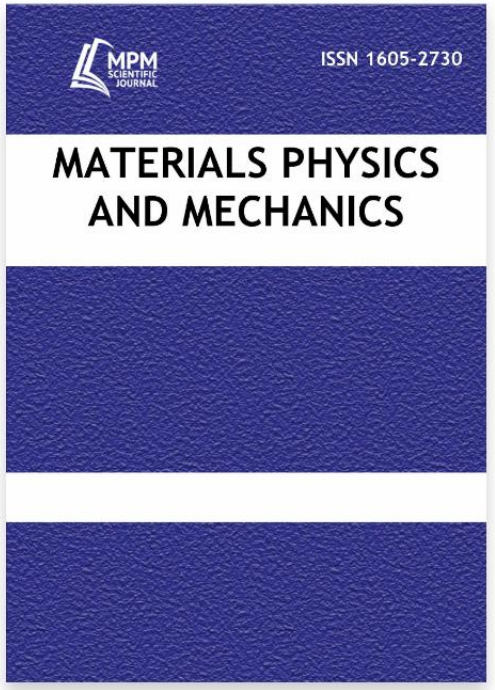
Open Access Journal

http://cap.physcon.ru

С 2016г в Scopus, Q3

Computer Science - Artificial Intelligence
- Computer Vision and Pattern Recognition
- Signal Processing
Mathematics
- Control and Optimization
Physics and Astronomy
- Physics and Astronomy (miscellaneous)
Chemical Engineering
- Fluid Flow and Transfer Processes

Materials Physics and Mechanics



Materials Physics and Mechanics

ISSN 1605-8119 С 2004г in Scopus, Q2-Q4

The international scientific journal "Materials Physics and Mechanics" is published by Peter the Great St. Petersburg Polytechnic University in collaboration with the Institute for Problems in Mechanical Engineering of the Russian Academy of Sciences.

- Mechanics of composite and nanostructured materials.
- Physics of strength and plasticity of composite and nanostructured materials.
- Mechanics of deformation and fracture processes in traditional materials (solids).
- Physics of strength and plasticity of traditional materials (solids).
- Physics and mechanics of defects in composite, nanostructured, and traditional materials.
- Mechanics and physics of materials in related fields.

Scientific research areas

IPM RAS carries out research in four main scientific areas:

Mechanics and physics of non-ideal and multiphase media

Extreme conditions of materials and structures

Nonlinear dynamics of machines, theory and methods of constructing machines with vibration, wave and impact principles of operation

Theory and methods of automatic control of machines and complex physical and technical systems under conditions of incomplete information

Laboratories

The structure of IPME RAS consists of 16 laboratories, scientific and educational center and unique scientific installation:

- Scientific and Educational Center of the Institute of Mechanical Engineering of the Russian Academy of Sciences and Youth Laboratory "Artificial Intelligence in Cyber-Physical Systems"
- A unique scientific facility: "Physics, Chemistry, and Mechanics of Crystals and Thin Films "

Laboratories

1. Mechanics and physics of non-ideal and multiphase media

- Laboratory of Structural and Phase Transitions in Condensed Matter
- Laboratory of Discrete models in mechanics
- Laboratory of Applied Research
- Laboratory of Micro-mechanics of Materials
- Laboratory of Modification of Material Surfaces
- Laboratory of Nanomaterials Mechanics and Theory of Defects
- Laboratory of Mathematical Methods in Mechanics of Materials

2. Nonlinear dynamics of machines, theory and methods of constructing machines with vibration, wave and impact principles of operation

- Laboratory of Mechatronics
- Laboratory of Vibrational Mechanics
- Laboratory of Friction and Wear

Laboratories

3. Extreme conditions of materials and structures

- Laboratory for Mathematical Modelling of Wave Phenomena
- Research Center of Dynamics
- Laboratory for Physics of Fracture

4. Theory and methods of automatic control of machines and complex physical and technical systems under conditions of incomplete information

- Control of complex systems
- Smart Electromechanical Systems (SEMS)
- Digitalization, analysis and synthesis of complex mechanical systems, networks and environments
- Adaptive and intelligent control of networked and distributed systems (AdIn))

Cooperation

St Petersburg University

Mathematics & Mechanics Faculty

RAS Academician Yu.V. Petrov
prof.. A.L. Fradkov
RAS Corresponding member N.V. Kuznetsov.

ITMO

ITMO University

prof. A.L. Fradkov
prof. I.B. Furtat

POLYTECH
Peter the Great St.Petersburg Polytechnic University

Institute of Physics and Mechanics

RAS Corresponding Member A.K. Belyaev
RAS Corresponding Member A.M. Krivtsov

Institute of Computer Science and Technology

prof. V.A. Polyanskiy

Prof.. S.A. Kukushkin
Prof.. A.V. Osipov,
Prof. A.V. Redkov.)

International cooperation

IPME RUSSIAN ACADEMY OF SCIENCES

Sandia National Laboratories

LAAS CNRS

Institut Ruđer Bošković

Loughborough University

Lawrence Livermore National Laboratory

Technion Israel Institute of Technology

Institute of Mechanics Chinese Academy of Sciences

University of Aberdeen

RWTH Aachen University

ACCM Austrian Center of Competence in Mechatronics

Linköping University

Aarhus Universitet

EPFL École Polytechnique Fédérale de Lausanne

TU Wien Technische Universität Wien / Vienna University of Technology

HIT 1920

TOPSiL

Cardiff University / Prifysgol Caerdydd

CICESE

Johannes Kepler Universität Linz | JKU

International cooperation

On September 16, 2024, the annual update of the Scopus ranking of the world's most cited scientists by number of citations was published.

10 employees of the Institute for Problems in Mechanical Engineering of the Russian Academy of Sciences were included in the ranking of the most cited scientists in the world.

Fradkov Alexander Lvovich
Nazarov Sergey Alexandrovich
Gutkin Mikhail Yurievich
Andrievsky Boris Rostislavovich
Porubov Alexey Viktorovich
Kukushkin Sergey Arsenievich
Sheinerman Alexander Grigorievich
Ovidko Ilya Anatolyevich (SPbPU)
Kuznetsov Nikolay Vladimirovich (SPbSU)
Krivtsov Anton Miroslavovich (SPbPU)

Laboratories

1. Laboratory for Mathematical Modelling of Wave Phenomena
(Head of the Laboratory: Dr. of Sc. **O.V. Motygin**)

Research directions :

- Theoretical study of wave processes in fluids, solids and continua with complex rheology
- Linear and non-linear wave dynamics of elastic and elastic-acoustic media, localization of waves on inclusions
- Wave and shock-wave processes in multicomponent models of continuum
- Rheological behaviour of nematic liquid crystals in micro and nanosized volumes
- Free boundary problems in hydrodynamics

Laboratories

1. Laboratory for Mathematical Modelling of Wave Phenomena (Head of the Laboratory: Dr. of Sc. **O.V. Motygin**)

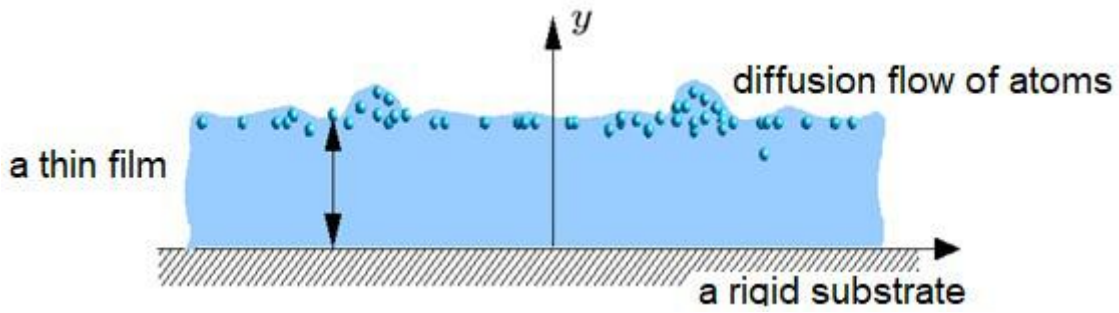
Research directions :

Wave localization in media with irregularities and inclusions with its own dynamics

- Elastic bodies with elastic with inclusions from multiple elements
- Localized dynamics of systems of the "fluid-elastic body" type

Non-stationary and non-linear waves

- Vibration of rods with different elastic moduli
- Movement of phase boundaries in a rod under wave excitation
- Diffusion growth of islands on the surface of a thin film

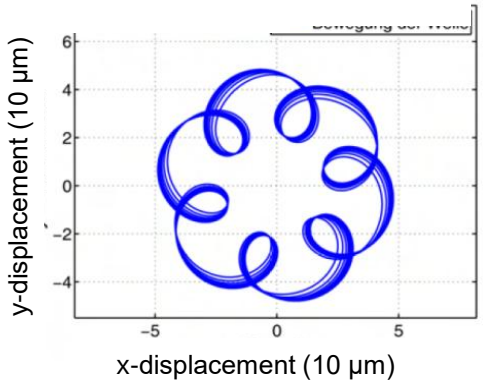


Laboratories

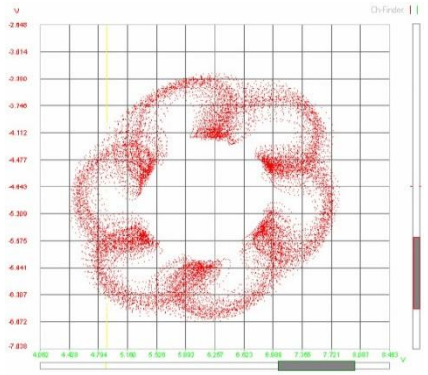
2. Laboratory of Mechatronics
(Head of the Laboratory: Prof. **A.K. Belyaev**)

Turbocharger dynamics and stability

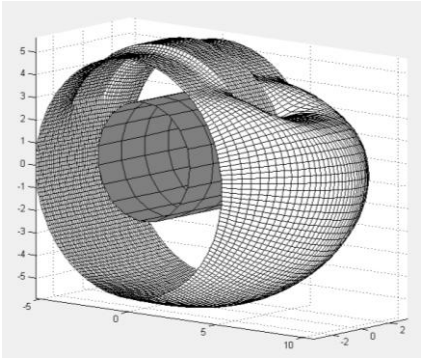
Rotor angular speed 214.600 rpm



Calculations



Test

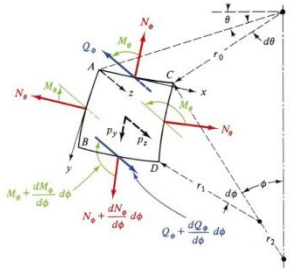


Distribution of oil pressure in a plain bearing

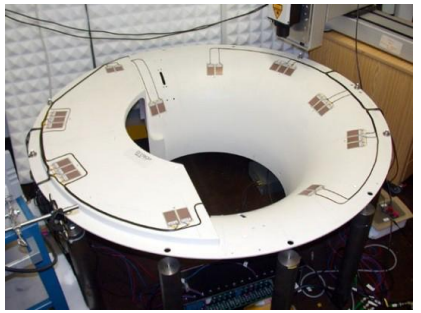
Laboratories

2. Laboratory of Mechatronics
(Head of the Laboratory: Prof. **A.K. Belyaev**)

Active vibration compensation of magnetic resonance imaging



Theory



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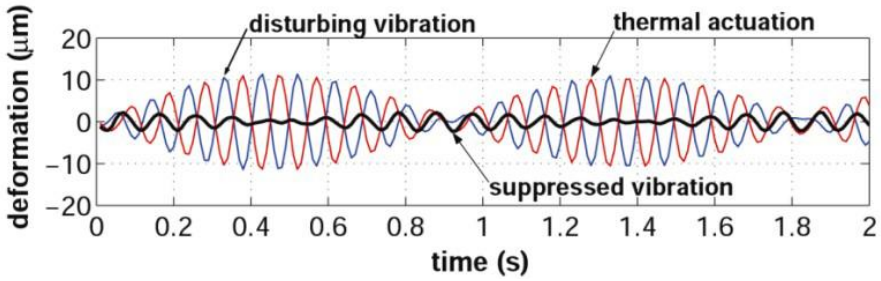
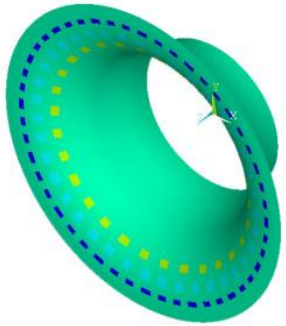
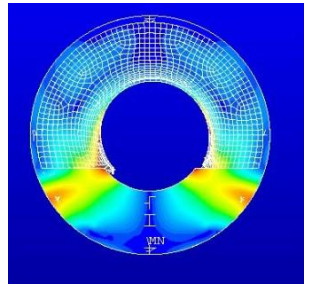
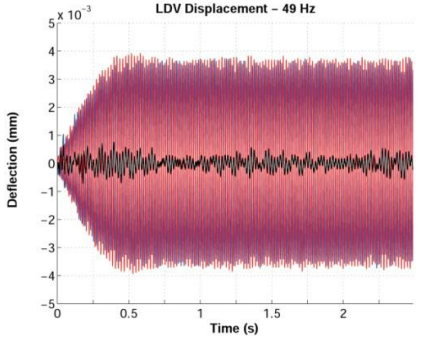






FEM



Laboratories

3. Laboratory of Nanomaterials Mechanics and Theory of Defects (Head of the Laboratory: Prof. M.Yu. Gutkin)

Research directions:

- The theory of defects, grains, plastic deformation and fracture mechanisms in nanocrystalline and nanocomposite materials.
- The theory of defects and grains in quantum dots, nanowires and nanolayers.
- The theory of defects, grains, plastic deformation and fracture mechanisms in coarse-grained polycrystals and composite materials.

Laboratories

4. Laboratory of Mathematical Methods in Mechanics of Materials (Head of the Laboratory: Prof. A.B. Freidin)

Research directions :

- Modeling the influence of thermomechanical impacts on phase transitions and chemical
- reactions in inhomogeneous materials
- Bio-mechanics
- Wave processes in cylindrical periodic waveguides - acoustic, quantum, elastic and
- piezoelectric, as well as waves on the surface of a liquid
- Asymptotic analysis of boundary problems with singular perturbations
- Spectral problems in areas with peak-like boundaries
- Modeling of the circulatory system, in particular, arterial and venous trees

Laboratories

4. Laboratory of Mathematical Methods in Mechanics of Materials (Head of the Laboratory: Prof. A.B. Freidin)

Research directions:

Mechanochemistry of promising anodes in lithium-ion batteries

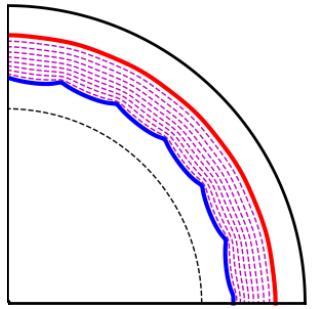
Motivation: fundamental component and engineering applications

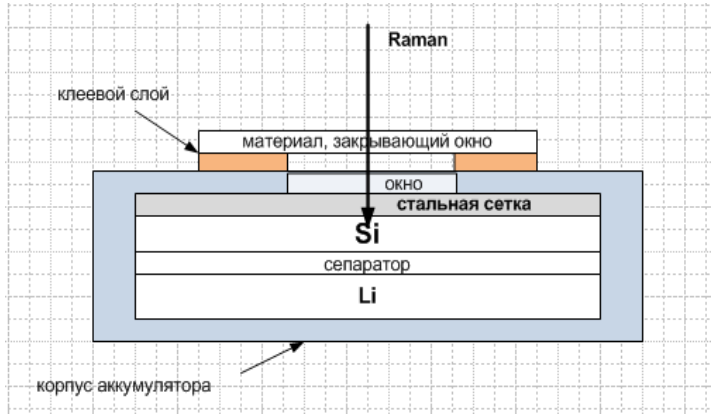
Objective: development of the mechanochemical theory of anode operation in a lithium-ion battery

Methods: simulation based on fundamental principles of continuum mechanics; experiments

Theoretical model: based on the concept of chemical affinity tensor

Effects of loss of stability of the reaction front





Assembling and testing the battery

Лаборатории

5. Laboratory of micro-mechanics of materials (Head of the Laboratory: Prof. A.V. Porubov)

Research directions:

- Study of nonlinear dynamic processes in media with complex internal structure and in
- metamaterials
- Investigation of the influence of microstructure on the conditions for the appearance and
- behavior of various defects
- Computer simulation of fluid behavior in nanosized channels and solids under deformation
- Development of analytical and numerical methods for solving nonlinear wave equations
- Development of numerical methods for studying processes in the bio-mechanical environment,
- liquids and solids, heat transfer and lubrication processes

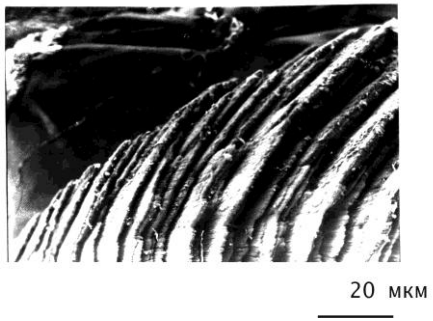
Laboratories

6. Laboratory of friction and wear
(Head of the Laboratory: Prof. **E.B. Sedakova**)

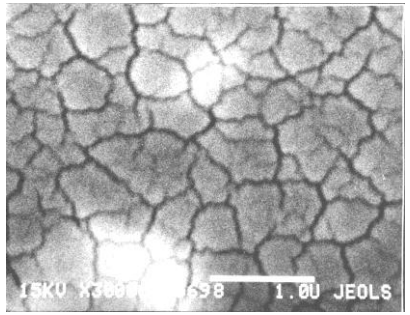
Research directions:

- The effect of friction on the structure and wear of a substance
- Objective: Fundamental properties. In-situ wear monitoring and diagnostics
- Methods: traditional, acoustic emission, wear product analysis
- Friction results:

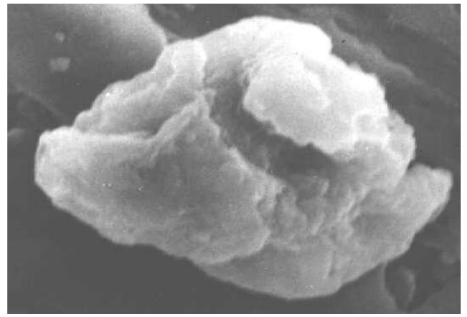
Friction results:



Metals.
Copper surface layer



Ceramics $SiC+SiO_2$
Cracks in SiO_2



Polyamide,
particle

Laboratories

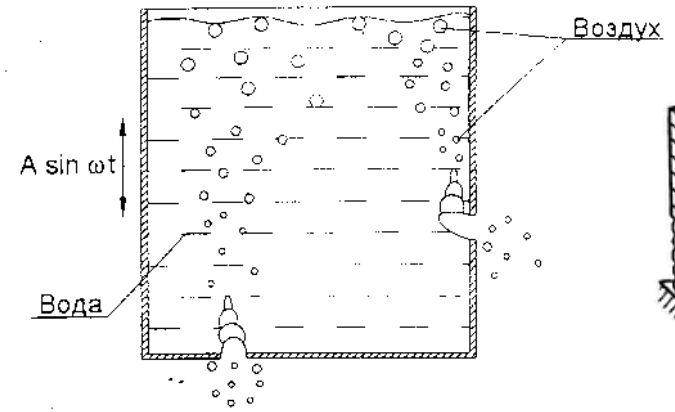
7. Laboratory of vibrational mechanics
(Head of the Laboratory: PhD. **L.I. Blekhman**)

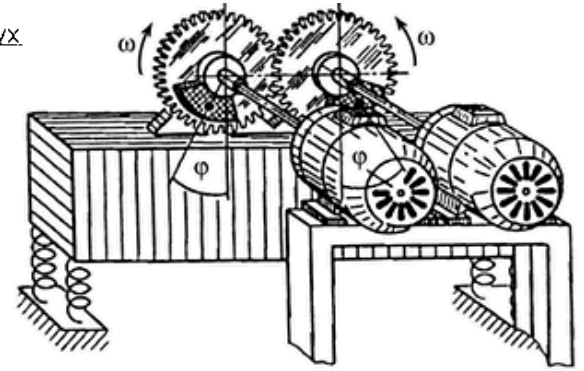
Research directions:

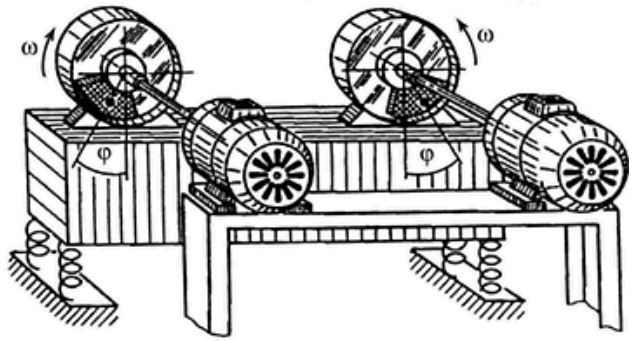
- Vibrational mechanics
- Vibrational rheology

Applications:

- Vibration engineering
- Purification of mineral products
- Mechanics of granular materials
- Vibrational transportation
- Synchronization of bodies of revolution
- Vibrational introduction of gas into liquid





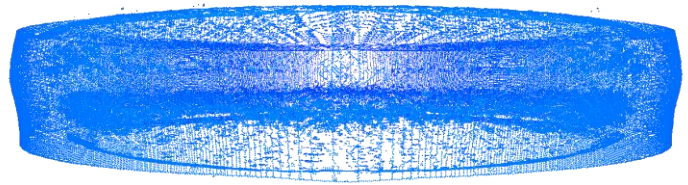


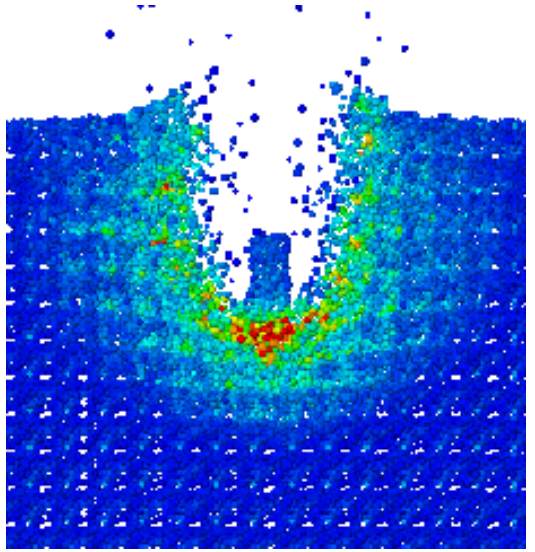
Laboratories

8. Laboratory “Discrete models of mechanics”
(Head of the Laboratory: Prof. **A.M. Krivtsov**)

Research directions:

- Multiscale particle simulation
- Molecular systems, nanostructures (>10^{-10}m)
- Media with microstructure, granular media (>10^{-7} m)
- Deformation and destruction of
- macroscopic bodies (>10^{-3} m)
- Astrophysical systems (>10^{3} m)



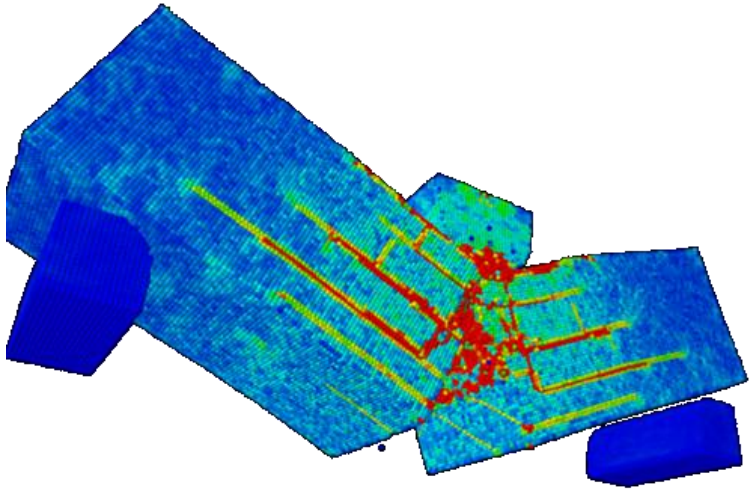


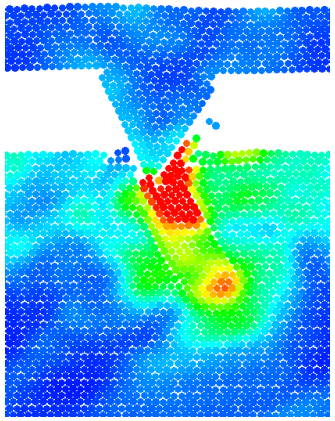
Laboratories

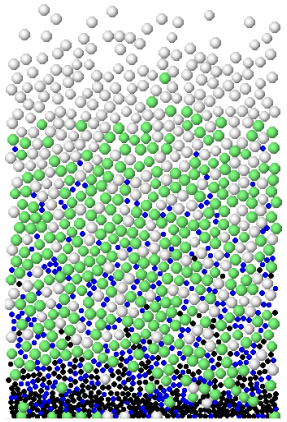
8. Laboratory “Discrete models of mechanics”
(Head of the Laboratory: Prof. **A.M. Krivtsov**)

Applications:

- Impact strength
- Penetration
- Spall fracture
- Segregation
- Drilling







Laboratories

9. Laboratory of structural and phase transitions in condensed matter (Head of the Laboratory: Prof. **S.A. Kukushkin**

Research areas:

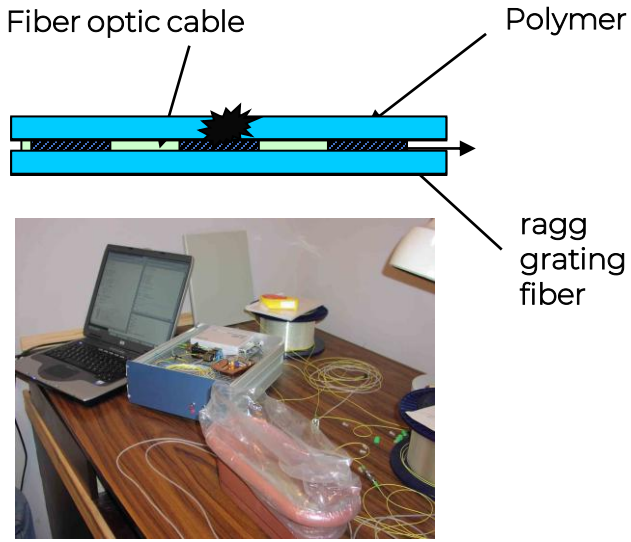
- Theoretical and experimental study of fundamental processes occurring during phase transformations in single- and multicomponent systems, nanomaterials, and thin films.
- First-order phase transitions, formation and growth of nanostructures, growth of thin films and protective coatings, growth of thin films of semiconductors and dielectrics for micro- and optoelectronics, micromechanics of deformable solids and fracture processes, theory of nonlinear phenomena and waves arising during phase transitions and crystallization processes.
- Formation of quantum dots.
- Switching effects in ferroelectrics and ferroelastics.
- Formation of pores and cracks in solids.

Laboratories

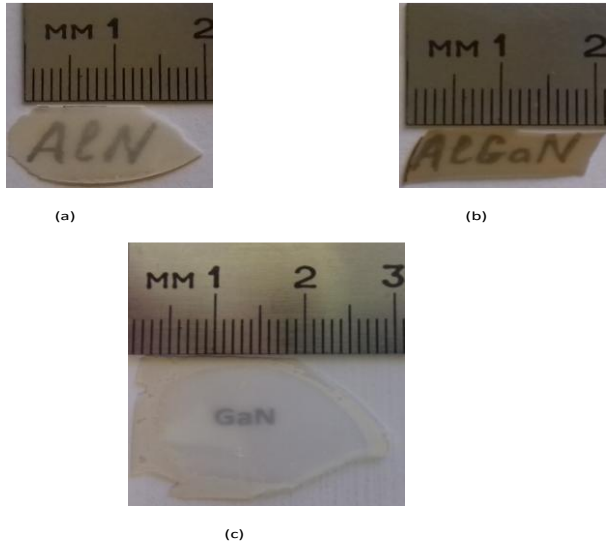
9. Laboratory of structural and phase transitions in condensed matter (Head of the Laboratory: Prof. **S.A. Kukushkin**)

Key results:

A working prototype of a fiber-optic oil leak detector has been created, operating on the basis of specially created micro- and nanopores in the fiber, which act as Bragg gratings.



For the first time, bulk layers of AlN, AlGaN and GaN were grown on SiC/Si(111).



(a) AlN 118 μm thick; (b) AlGaN bulk layers 450 μm thick; (c) GaN bulk layers 180 μm thick.

Laboratories

9. Laboratory of structural and phase transitions in condensed matter (Head of the Laboratory: Prof. **S.A. Kukushkin**

Key results:

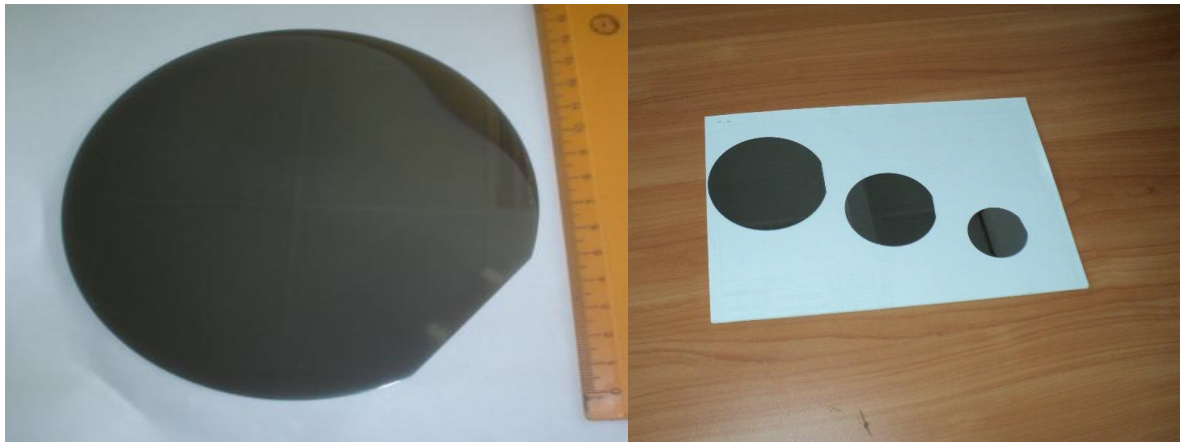
- A fundamentally new method for depositing silicon carbide on silicon has been theoretically proposed and experimentally implemented. This method involves creating dilatational dipoles in the substrate matrix structure by replacing the main Si atoms with dilatational dipoles. The creation of dilatational dipoles resulted in the replacement of silicon matrix atoms with carbon atoms, forming silicon carbide molecules without the occurrence of elastic stress!
- Based on this method, a completely new innovative technology for producing heterostructures based on wide-bandgap semiconductors for micro- and optoelectronics on silicon substrates has been developed.
- For the first time in world practice, an LED structure has been obtained on a silicon substrate with a nanoscale silicon carbide buffer layer. For the first time, at least in Russia, a working prototype of an LED on silicon has been produced!
- The scientific and technological foundations have been laid for the industrial production of LED heterostructures on silicon with a nanoscale silicon carbide buffer layer. One of the key challenges in modern microelectronics has been addressed: fundamental and applied principles have been developed for synthesizing wide-gap semiconductor heterostructures of Group V nitrides on silicon. These structures can be used to create a wide range of devices, from LEDs, transistors, and lasers to various sensors and other micro-optoelectronics devices.
- A new type of coupled first-order phase transition during the formation of multicomponent solid phases in solids has been theoretically predicted and experimentally detected.

Laboratories

9. Laboratory of structural and phase transitions in condensed matter (Head of the Laboratory: Prof. **S.A. Kukushkin**)

Key results:

Samples of silicon carbide films on Si substrates with diameters of 2, 3, 4 and 6 inches (150 mm)



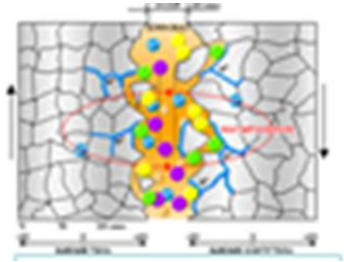
LEDs based on GaN/AlGaN/AlN heterostructures grown on a silicon substrate with a silicon carbide buffer layer

Laboratories

10. Laboratory of applied research (Head of the Laboratory: PhD. **Yu.A. Yakovlev**)

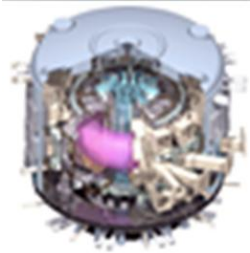
Research directions:

- Hydrogen diagnostics
- Effect of hydrogen on fatigue strength and delayed fracture
  - Destruction of friction surface
  - Destruction of rolling bearings
  - Destruction of wheels of high-speed trains
  - Turbine engine blades
  - High-strength fasteners in construction, automotive and aviation industry
  - Materials for nuclear and thermonuclear power engineering










Laboratories

10. Laboratory of applied research
(Head of the Laboratory: PhD. **Yu.A. Yakovlev**)

Research directions:

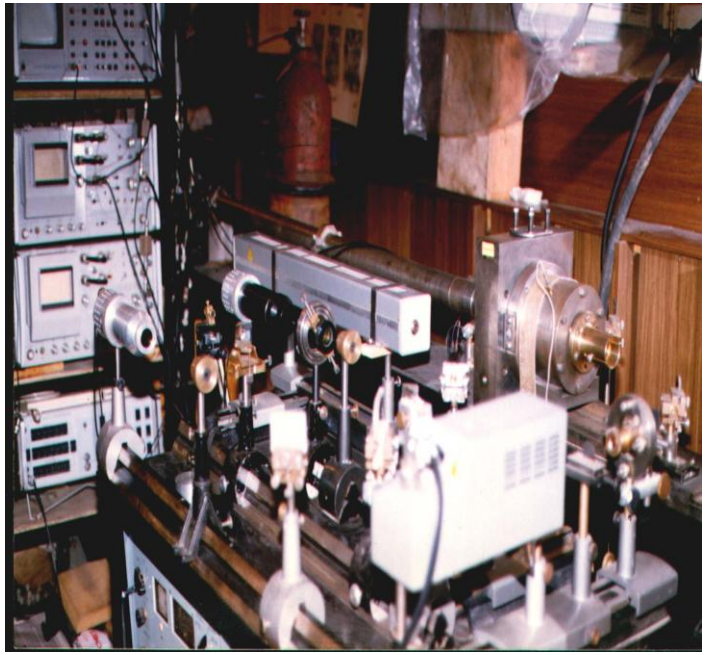
- Simulation of stress corrosion in gas pipeline walls
- Brittle fracture due to hydrogen cracking

Laboratories

11. Laboratory of fracture physics
(Head of the Laboratory: Prof. Yu.I. Meshcheryakov)

Research directions:

- Shock loading equipment - gas guns
- Laser interferometry of shock wave processes
- In-situ monitoring of average particle velocity profiles and
- distribution of particle velocities
- Shock waves in solids
- Dynamic deformation and fracture
- Spall
- Phase transitions under impact in solids

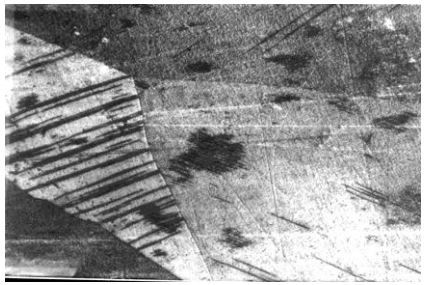


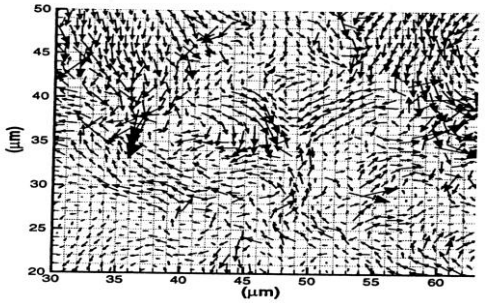
Laboratories

11. Laboratory of fracture physics
(Head of the Laboratory: Prof. **Yu.I. Meshcheryakov**)

Research directions::

- Microstructural studies of samples after impact
- X-ray analysis
- Turbulization under impact
- Shear band formation
- Meso-macro energy, exchange of moments
- Structural instability criteria





$$\left(\frac{D}{u}\frac{\dot{D}}{\dot{u}}\right) \geq 1$$

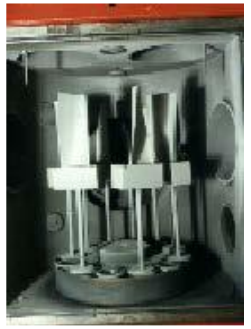
$$\Delta u = -\frac{1}{2}\frac{\partial D}{\partial u}$$

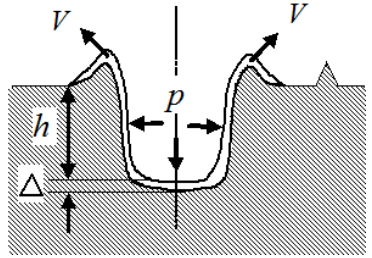
Laboratories

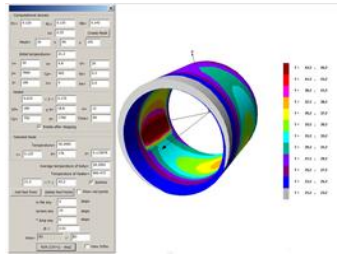
12. Laboratory “Modification of material surfaces” (Head of the Laboratory: Prof. **V.G. Kuznetsov**)

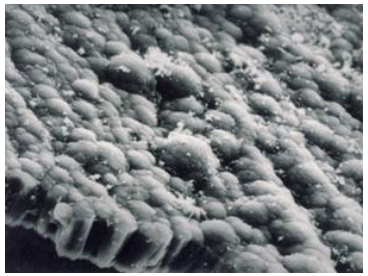
Research directions::

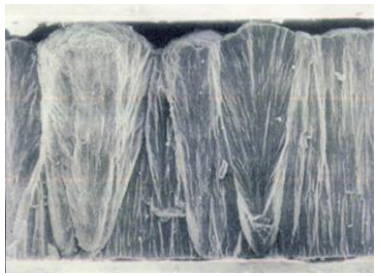
- Development of new ion-plasma technologies for controlling the structure and physical and mechanical properties of materials.
- Mechanics and physics of the interaction of a vacuum arc cathode spot with a solid surface.
- Development of plasma-chemical synthesis methods for materials to create superhard coatings, carbon nano- and microstructures, and powdered carbon composites.











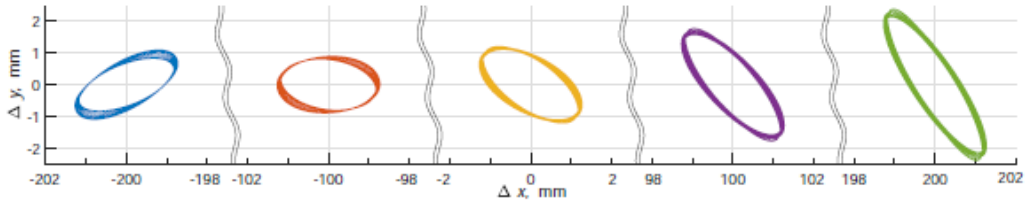
Laboratories

13. Laboratory “Control of complex systems” (Head of the Laboratory: Prof. **A.L. Fradkov**)

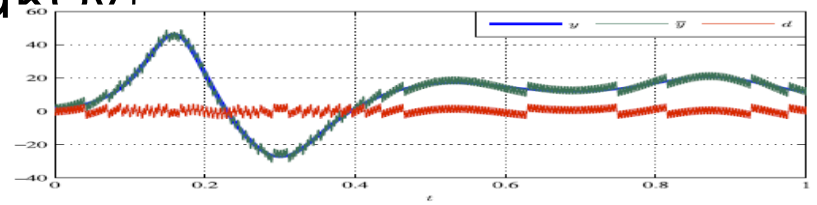
Control of oscillatory and wave processes in physical and technical systems:

Synchronization of nonlinear system oscillations under communication constraints

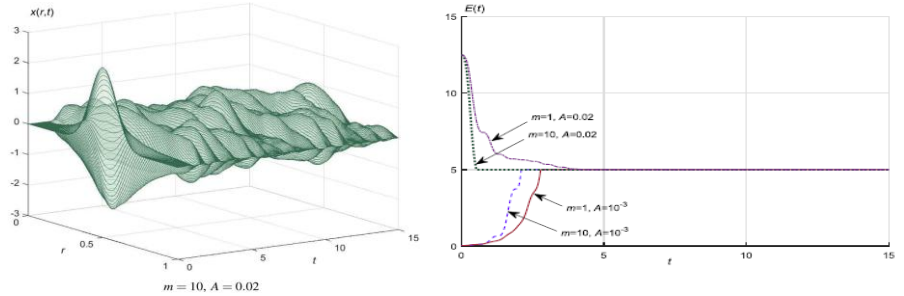
- Control of spatially distributed system oscillations
- Control of excitation and synchronization of vibration machine rotors



Vibration of the test bench platform during phase shift (experiment).



Transmission of a quantized signal on a chaotic carrier over a communication channel



Convergence of the energy E(t) of the sine-Gordon system to a given

Mechatronic vibration stand SV-2M IPMash RAS

Laboratories

13. Laboratory “Control of complex systems” (Head of the Laboratory: Prof. **A.L. Fradkov**)

Fradkov, A.L., Andrievsky, B., Ananyevskiy, M.S. Passification based synchronization of nonlinear systems under communication constraints and bounded disturbances// **Automatica**, 2015, 55, pp. 287-293

Andrievsky, B., Fradkov, A.L., Liberzon, D. Robustness of Pecora–Carroll synchronization under communication constraints// **Systems & Control Letters**, 2018, 111, pp. 27-33.

Y. Orlov, A. Fradkov, B. Andrievsky. Energy control of distributed parameter systems via speed-gradient method: Case study of string and sine-Gordon benchmark models// **Int. J. Control**, vol. 90, no. 11, pp. 2554–2566, 2017.

Orlov, Y., Fradkov, A.L., Andrievsky, B. Output Feedback Energy Control of the Sine-Gordon PDE Model Using Collocated Spatially Sampled Sensing and Actuation // **IEEE Trans. Automatic Control**, 2020, 65(4),8733021, pp. 1484-1498.

Porubov, A., Andrievsky, B. Control methods for localization of nonlinear waves // **Phil. Trans. Royal Society A.** 2017, 375(2088).

Fradkov, A., Gorlatov, D., Tomchina, O., Tomchin, D. Control of oscillations in vibration machines: Start up and passage through resonance // **Chaos**. 2016, 26(11),116310.

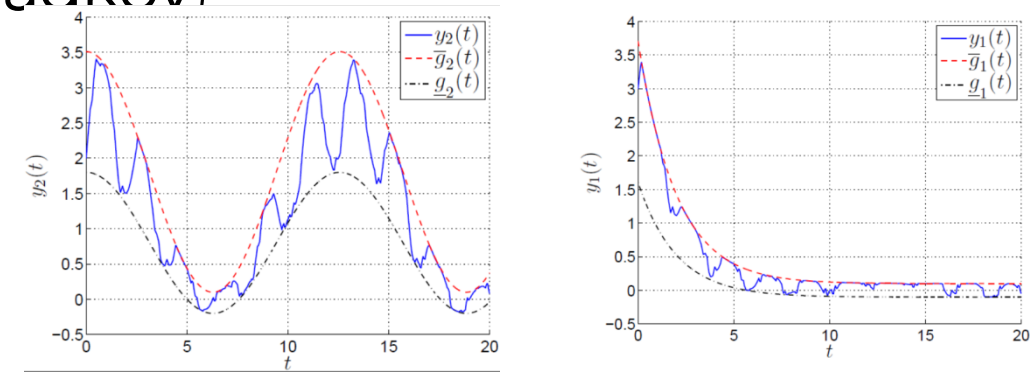
A.L. Fradkov, O.P. Tomchina, B. Andrievsky, V. I. Boikov. Control of Phase Shift in Two-Rotor Vibration Units // **IEEE Trans. Control Systems Technology**, doi: 10.1109/TCST.2020.2983353

Laboratories

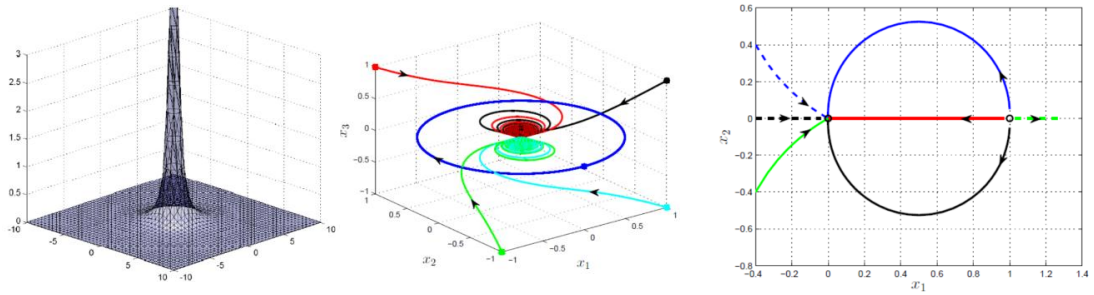
13. Laboratory “Control of complex systems” (Head of the Laboratory: Prof. A.L. Fradkov)

Stability and control of technical systems with application to electric power networks

- Divergent Stability Conditions for Dynamic Systems
- Adaptive, Robust, and Nonlinear Control of Technical Systems
- Control of Delayed Systems
- Synchronization in Electric Power Grids



Nonlinear robust control with provision of object variables in a given set



Study of system stability using divergent methods

Power grid management stand

Laboratories

13. Laboratory “Control of complex systems” (Head of the Laboratory: **A.L. Fradkov**)

Furtat I.B., Fradkov A.L. Robust control of multi-machine power systems with compensation of disturbances // International Journal of Electrical Power & Energy Systems. 2015. Vol. 73. P. 584–590.

Furtat I.B., Fradkov A.L., Liberzon D. Compensation of disturbances for MIMO systems with quantized output // Automatica. 2015. Vol. 60. P. 239–244.

Furtat I., Fridman E., Fradkov A. Disturbance Compensation With Finite Spectrum Assignment for Plants With Input Delay // IEEE Transactions on Automatic Control. 2018. Vol. 63, no. 1. P. 298-305.

Furtat I., Orlov Y., Fradkov A. Finite-time sliding mode stabilization using dirty differentiation and disturbance compensation // International Journal of Robust Nonlinear Control. 2018; 1–17. https://doi.org/10.1002/rnc.4273

Furtat I. B. Control of nonlinear systems with compensation of disturbances under measurement noises // International Journal of Control, DOI: 10.1080/00207179.2018.1503723

Furtat I., Gushchin P. Tracking control algorithms for plants with input time-delays based on state and disturbance predictors and sub-predictors // Journal of the Franklin Institute, 2019, 356, pp. 4496-4512.

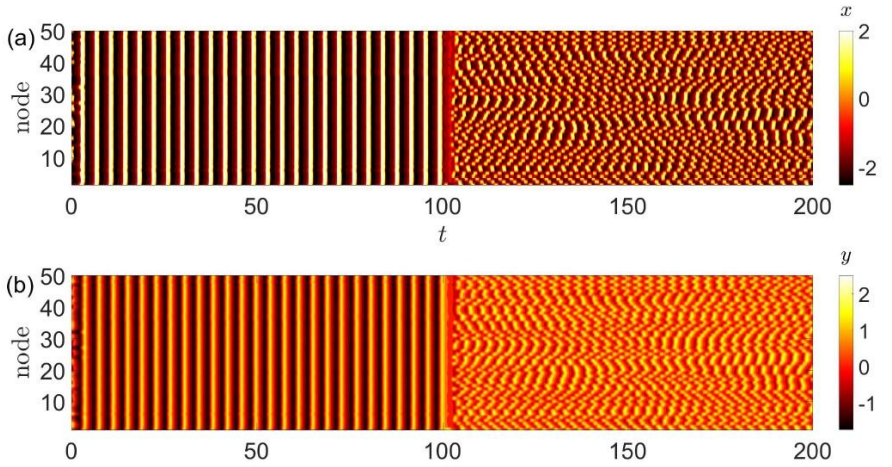
Furtat I.B. Divergent Stability Conditions of Dynamic Systems // Automation and Remote Control, 2020, 81:2, pp. 247–257.

Laboratories

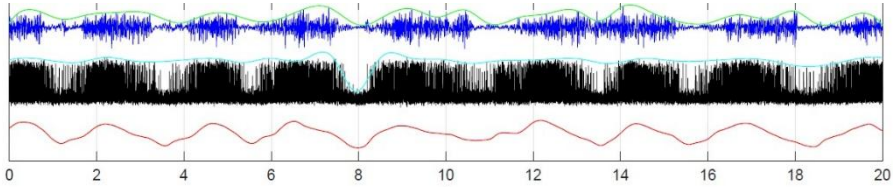
13. Laboratory “Control of complex systems” (Head of the Laboratory: Prof. A.L. Fradkov)

Control and dynamics in neural networks of the brain

- Study of bifurcations and complex dynamics in neural networks (synchronization, cluster synchronization, chimera state, desynchronization)
- Synthesis of algorithms for controlling neural network dynamics
- Study of brain rhythms and development of models for the dynamics of these rhythms



Desyncronization control in a FitzHugh-Nagumo network. Without control before t=100 – synchronization; with control after t=100 – desyncronization.



The relationship between the slow brain rhythm (red) and the fast gamma rhythm (blue), as well as modeling the dynamics of the gamma rhythm (black).

Plotnikov S.A., Lehnert J., Fradkov A.L., Schoell E. Synchronization in heterogeneous FitzHugh-Nagumo networks with hierarchical architecture // Phys. Rev. E. — 2016. — Vol. 94, Issue 1. — 012203.

Plotnikov S.A., Fradkov A.L. On synchronization in heterogeneous FitzHugh–Nagumo networks // Chaos, Solitons & Fractals. — 2019. — Vol. 121. — P. 85-91.

Laboratories

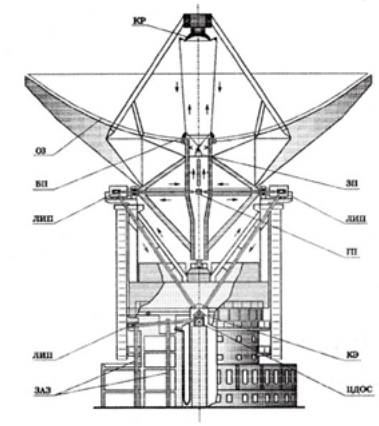
14. Smart Electromechanical Systems (SEMS)
(Head of the Laboratory: Dr. of Sc. **A.Yu. Kuchmin**)

Research directions:

- Theoretical research of dynamic processes in Smart ElectroMechanical Systems
- (SEMS)
- Mathematical and Computer modeling SEMS
- Central nervous system hardware and software SEMS
- Optimal SEMS control under conditions of uncertainty
- Algebraic methods for processing sensory and semantic data and inference
- Physical and statistical aspects of rarely progressive processes
- Adaptive fiber channel and robot systems
- Self-adapting optoelectronic elements

Laboratories

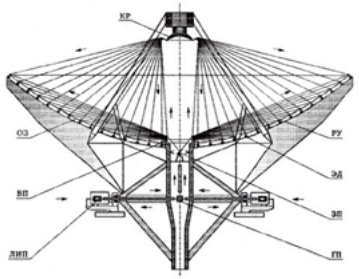
14. Smart Electromechanical Systems (SEMS)
(Head of the Laboratory: Dr. of Sc. **A.Yu. Kuchmin**))



РТ-70.
СХЕМА ОРГАНИЗАЦИИ СИСТЕМЫ ТОЧНОГО НАВЕДЕНИЯ.

Главное зеркало радиотелескопа РТ-70 параболоид вращения диаметром 70 метров с фокусным расстоянием F = 21 метр и углом раскрыва 160°. Рабочий диапазон длин волн от дециметрового до миллиметрового, вплоть до одного миллиметра. Компенсация эксплуатационных деформаций зеркальной системы радиотелескопа вызванных весовыми, ветровыми нагрузками и колебаниями температуры осуществляется за счет «гомологической» конструкции в длинноволновых диапазонах и активной подстройкой формы главного зеркала в диапазоне миллиметровых длин волн («адаптивное зеркало»). Точность профиля главного зеркала после коррекции не хуже 60 мкм.

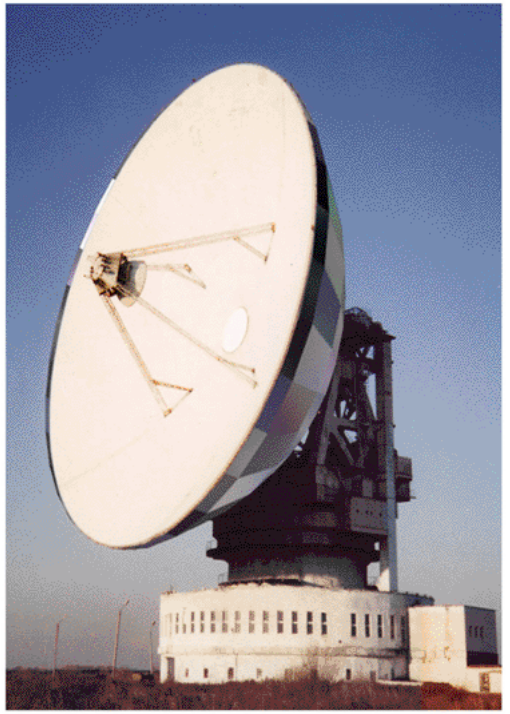
Схема облучения зеркала радиотелескопа – двухзеркальная схема Грегори с дополнительным перископическим зеркалом. Проектная точность установки и наведения антенны на наблюдаемый объект одна угловая секунда. Достигается такая точность благодаря применению специального гироскопического гида- построителя и высокоточных цифровых датчиков угла.
Общий вес металлоконструкций радиотелескопа РТ-70 более 5000 тонн.



РТ-70.
СХЕМА ИЗМЕРЕНИЯ ФОРМЫ ПОВЕРХНОСТИ ОСНОВНОГО ЗЕРКАЛА.

Условные обозначения:

- КР - контррефлектор
- ОЗ - основное зеркало
- БП - базовая платформа
- РУ - репорные устройства
- ЭД - электродомкраты отражающих панелей
- ЗП - зеркало перископическое
- ЛИП - лазерные измерители положения
- ГП - гид-построитель
- КЭ - контрольный элемент
- ЦДОС - цифровой датчик обратной связи
- ЗАЗ - задатчик азимута



РТ-70.

ОБЩИЙ ВИД РАДИОТЕЛЕСКОПА.

Laboratories

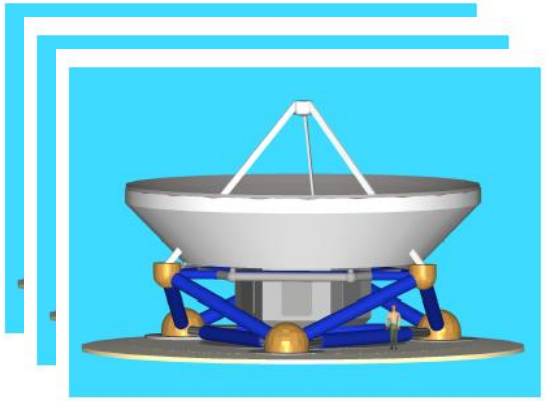
14. Smart Electromechanical Systems (SEMS)
(Head of the Laboratory: Dr. of Sc. **A.Yu. Kuchmin**)

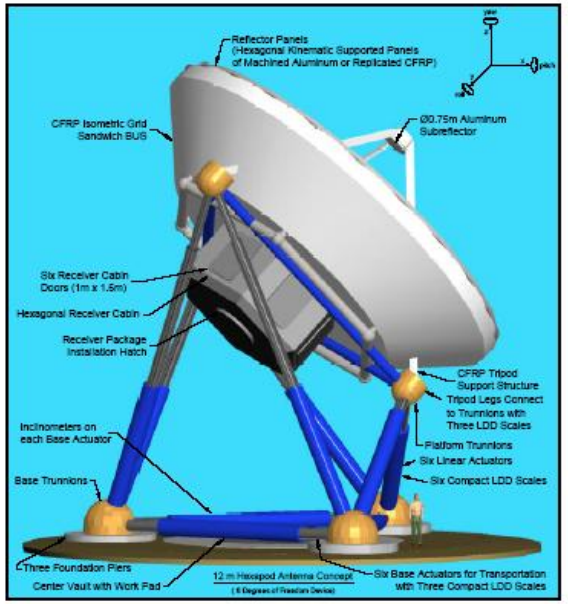
Research and development of technology for the creation of intelligent electromechanical systems

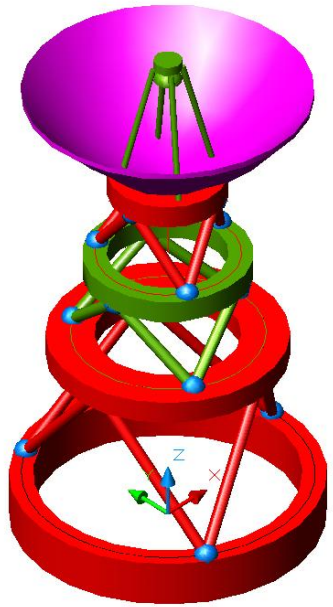
Developing technology for creating basic SEMS elements

a range of multipods for various purposes for constructing SEMS, which can be used in the following areas of technology:

- antenna installation slewing bearings;
- weapon and launcher platforms;
- robots and manipulators



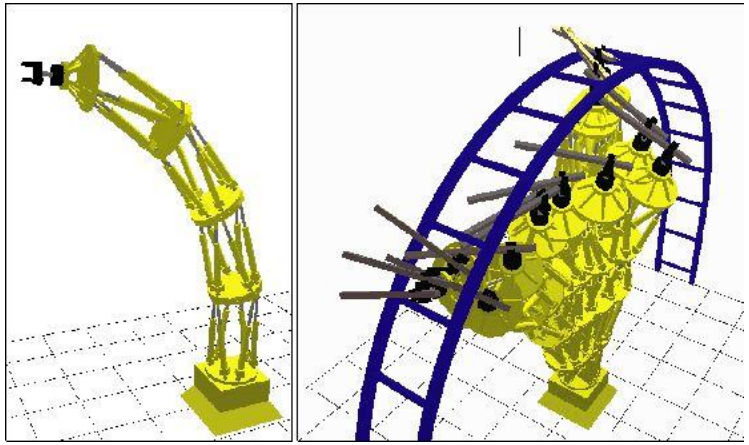


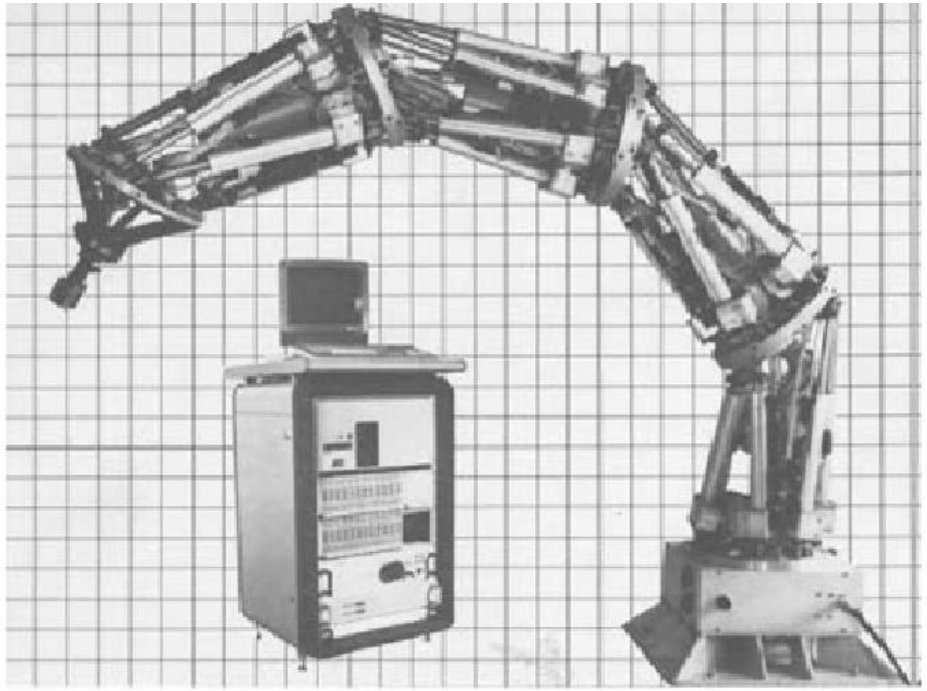


Laboratories

14. Smart Electromechanical Systems (SEMS)
(Head of the Laboratory: Dr. of Sc. **A.Yu. Kuchmin**)

Gun and launcher platforms.
Provide fast and accurate targeting across the entire range of angles without requiring rotation of the vehicles themselves.
Provide fast and accurate targeting across the entire range of angles without requiring rotation of the vehicles themselves.

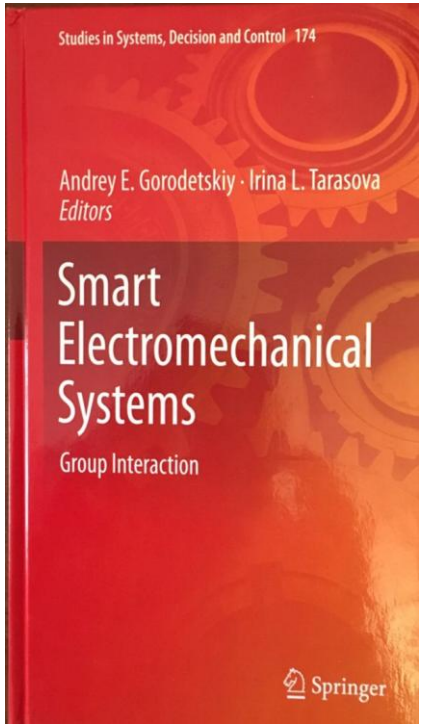


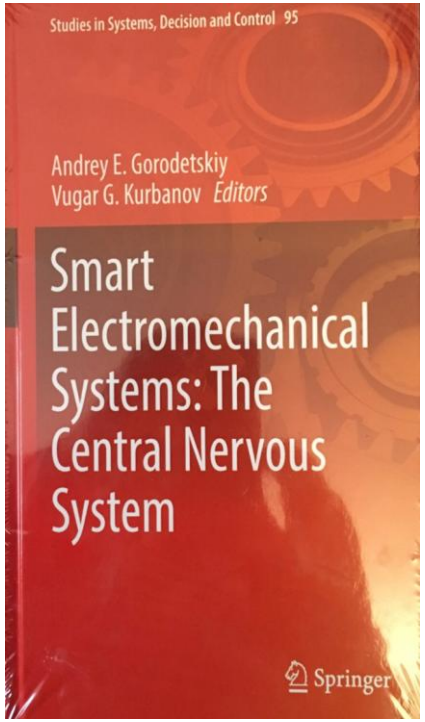


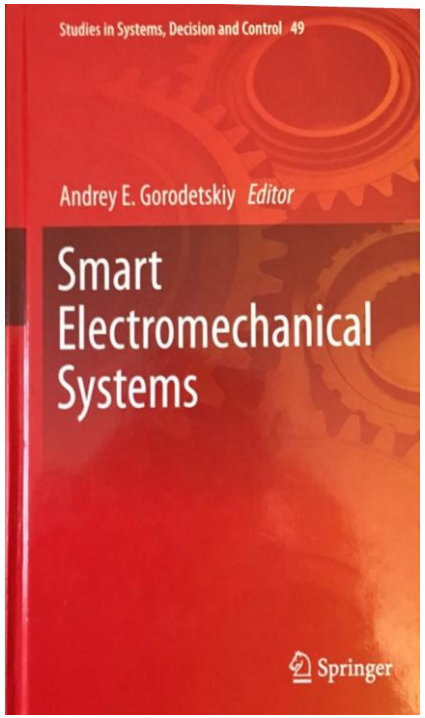
Laboratories

14. Smart Electromechanical Systems (SEMS)
(Head of the Laboratory: Dr. of Sc. **A.Yu. Kuchmin**)

Books







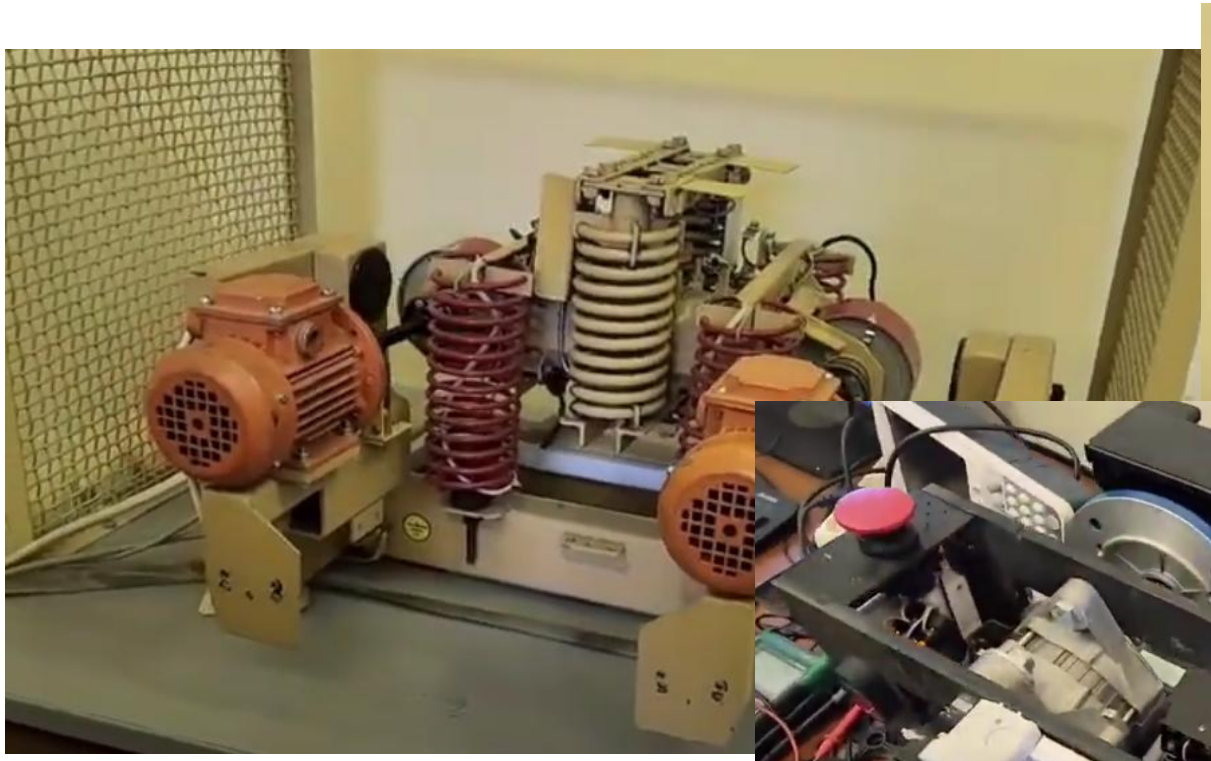
Laboratories

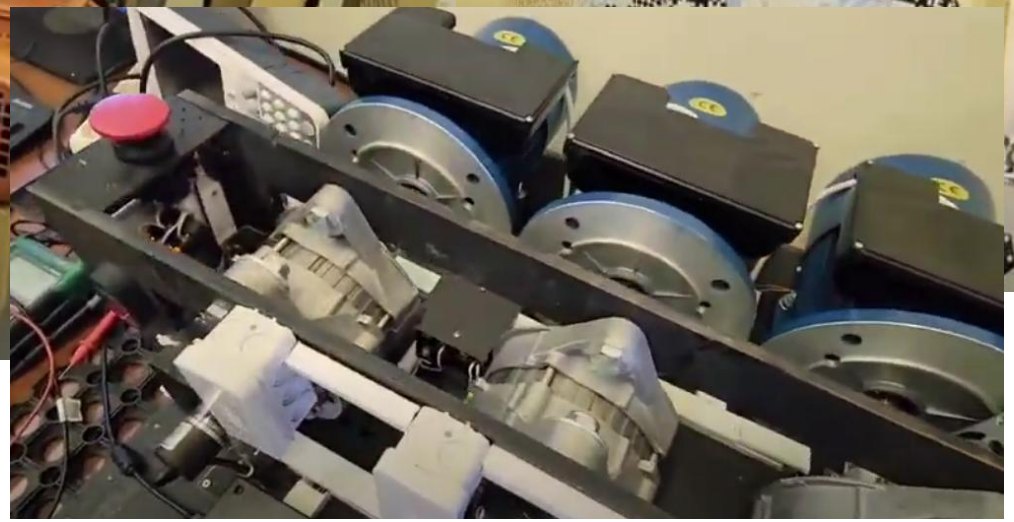
15. Digitalization, analysis and synthesis of complex mechanical systems, networks and environments

Head of the Laboratory: PhD. S.A. Plotnikov

Scientific and Educational Center, youth laboratory

16 Adaptive and intelligent control of networked and distributed systems (AdIn) (Head of the Laboratory: Dr. of Sc., Prof. I.G. Furtat)





REC

Research and Educational Center
“Artificial intelligence in cyber-physical systems”(REC AI-CPhS).
Director: Dr. of Sc., Prof. A. L. Fradkov.

Artificial intelligence in mechatronic and cyber-physical systems

(Dr. of Sc. A. K. Belyaev)

Intelligent control in networked cyberphysical systems under communication and transport restrictions

(Dr. of Sc. A. L. Fradkov))

Artificial intelligence and neurotechnologies in robotics and medicine

(Phd. S. A. Plotnikov)

Power-industry management with artificial intelligence

(Dr. of Sc. I. B. Furtat)

Management of multi-agent mobile systems and geoscanning

(Dr. of Sc. O. N. Granichin)