Al-Farabi Kazakh National University

Department of Mechanics

Speaker: **Zaure Rakisheva**

TSUKUBA, JAPAN
MARCH, 2019

University profile: facts and figures

•**University Profile**

➢ **15** Faculties

➢ **67** Departments

➢ **59** Scientific Research Institutes and Centers

➢ **294** Research, Educational-Research and Educational laboratories

➢ A scientific technological techno-park

• **Faculty profile**

➢ More than **2,000** professors, doctors, and PhD's

➢ More than **100** members of academy of sciences

➢ about **30** researchers who received highest national awards of the Republic of Kazakhstan

➢ more than **30** laureates of State Awards of RK

➢ **40** laureates of the young scientists' awards

➢ **45** fellows of state scientific fellowships

• **Students profile**

➢ Enrolment of the University in both cycles amounts to more than 20 000 students including **1,000** overseas students

Department on Mechanics

One of the eldest in al-Farabi KazNU

Was established in **1935** (KazNU – in 1934)

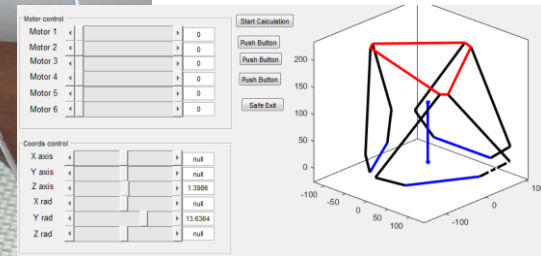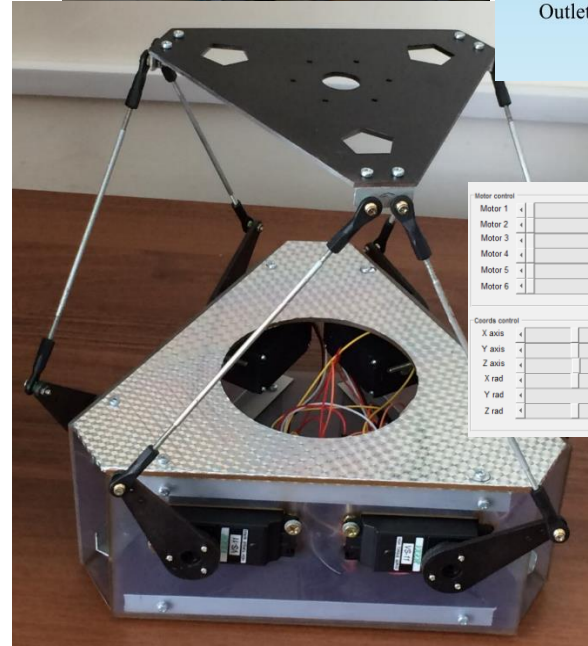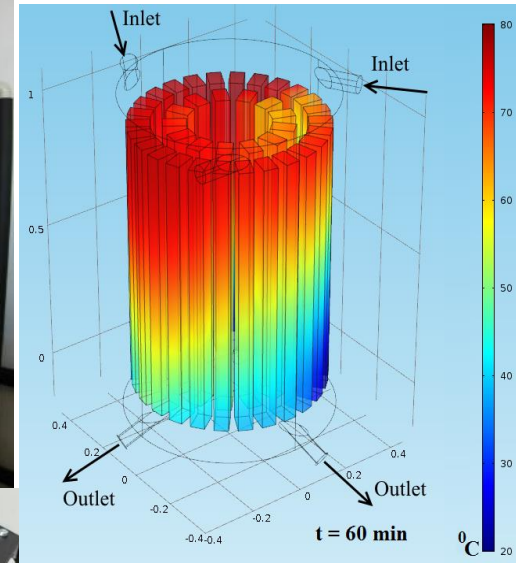Three levels of training in this specialty:

1. 5B060300 – Bachelor Program;

2. 6M060300 – Master Program;

3. 6D060300 – PhD Program.

Main directions of development of educational and scientific activities:

Theoretical and celestial mechanics

Fluid mechanics (plus renewable energy)

Mechanics of machines and mechanisms (plus robotics)

Space engineering and technologies

In 2005 – Kazakhstan starts the own Space Program

In 2010 Department on Mechanics opens the new specialty «Space engineering and technologies».

Now we implement three levels of training in this specialty:

1. 5B074600 – Bachelor Program (since 2010);

2. 6M074600 – Master Program (since 2012);

3. 6D074600 – PhD Program (since 2013).

In 2014 – first issue of bachelors and masters

In 2016 - first PhD defended his thesis

Space engineering and technologies

In 2015 by National Program of Innovative and Industry Development of RK (NPIID-2) new individual education trajectories «Information technology of space monitoring systems» had been opened within Master Program on specialty «Information systems» on Department on Mechanics.

IET «Information technology of space monitoring systems» is realized at the including the subjects from the project Tempus-SESREMO concerning space monitoring.

Within the NPIID-2 for enrollment 2016 the new IET was developed in addition «Design of the spacecraft».
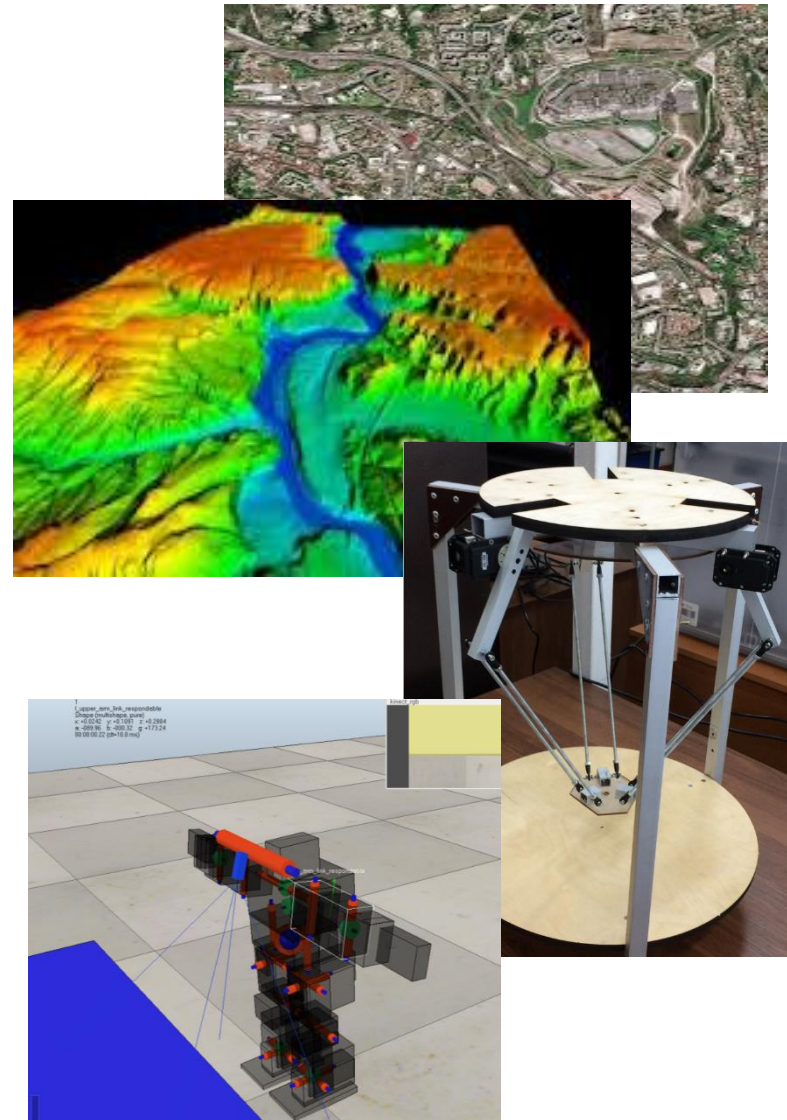
International projects

Strengthening education in space-based remote sensing for monitoring of eco systems in Israel, Azerbaijan, Kazakhstan (SESREMO)
2014-2017

Applied curricula in space exploration and intelligent robotic systems (APPLE)
**2016-2019**

SESREMO (implementation and results)

Title of the project: Strengthening education in Space-based remote sensing for monitoring of eco systems in Israel, Azerbaijan, Kazakhstan / SESREMO

Aim of the project: ensuring that the target Universities in AZ, IL and KZ can offer two cycle programmes in Space Based Remote Sensing Techniques to improve teaching in line with the new development in the area, the market demand and according to the Bologna Process, last recommendations in Bucharest communiqué and best practice.

The *mission of the project* is to introduce the applied educational program by reviewing/analyzing/upgrading the current curricula to recent advances in the target field; to develop, implement and accredit the new curricula inclusive B-learning and M-Learning; to modernize the existing and to establish the new equipped labs for effective education in frames of new educational program; retrain of academic staff/mentors in frames of new curricula; to conduct pilot teaching with the support of the stakeholders.

Research works of our master students in specialty «Information technology of space monitoring systems» (enrollment 2015)
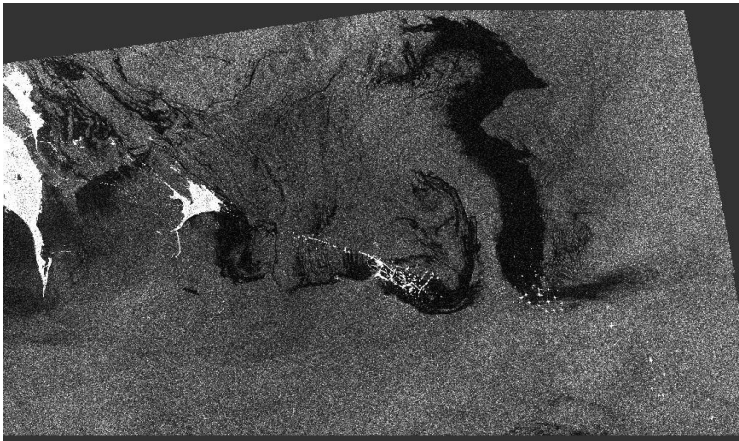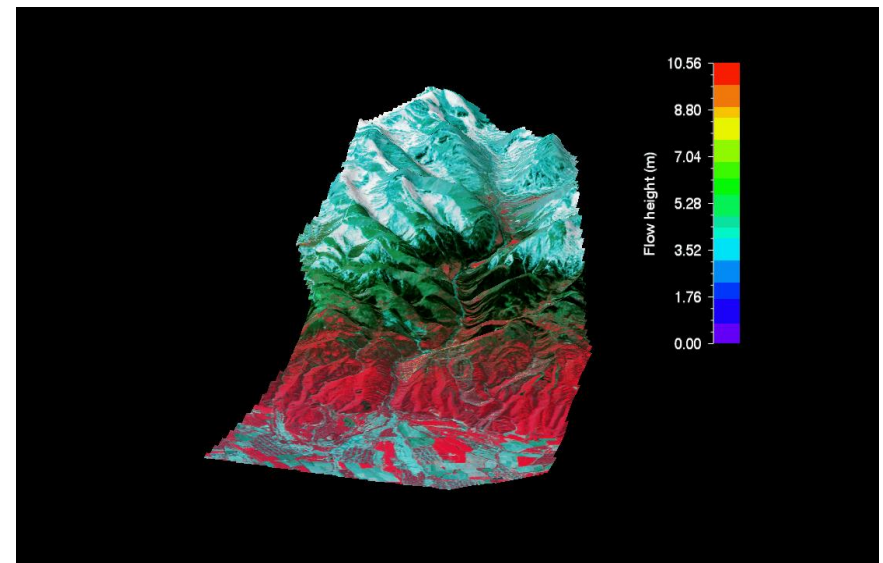

Satellite monitoring of oil in water reservoirs

Radar images were processed to monitor oil spills in the reservoirs of the RK and Azerbaijan

Space monitoring to predict and assess the situation of mudflow in Ile-Alatau

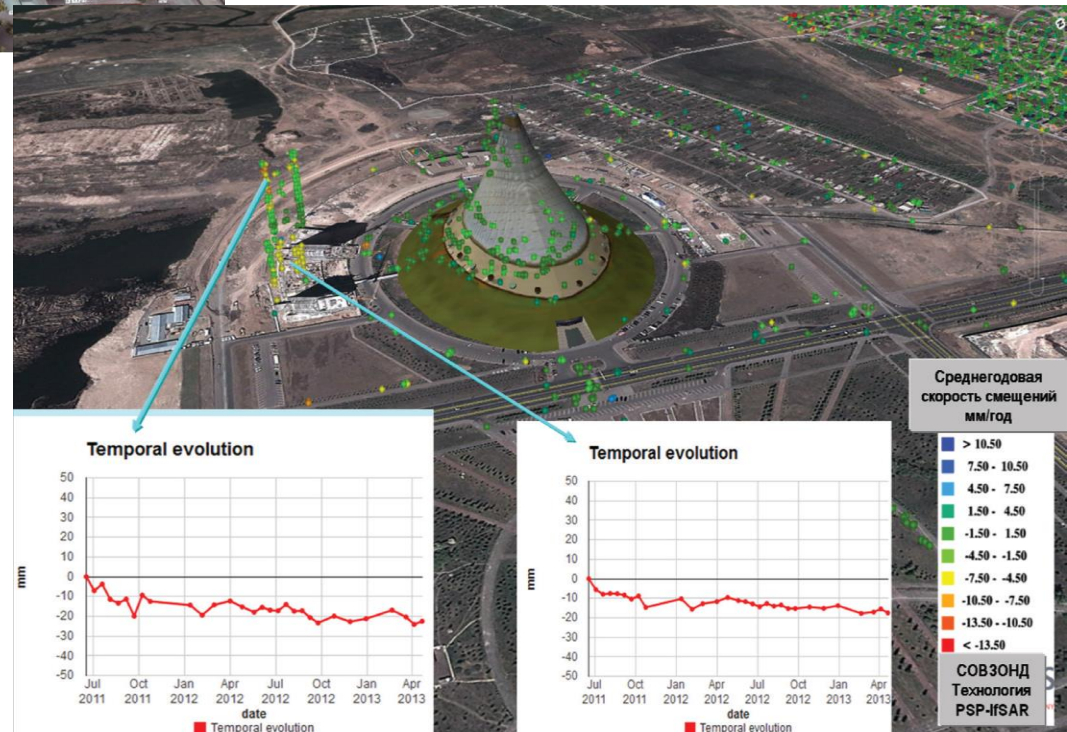Monitoring and assessment of the mudflow regions in Ile-Alatau for the mudflow forecasting

3D Zhezkazgan city

The three-dimensional model of the Zhezkazgan city was created based on the data of remote sensing and topographic maps

Vertical displacements of points of the Earth surface of the Astana city

Monitoring of the vertical displacement of the Earth's surface points in Astana was done using the interferometry method

ECOLOGICAL MONITORING SERVICE OFFICE

Together with the Faculty of Geography and Environmental Sciences we had organized the **Center of Space technologies and RS**. It was approved by Academic Council of KazNU (prot. №3 from 26.12.2016)

The MoU had signed with:

- University of Twente (Netherlands)
- Berlin Technical University (Germany)
- Embry-Riddle Aeronautical University (USA)
- Samara State Aerospace University (Russia)
- JSC «Galam» (Kazakhstan)

APPLE

Title of the project: Applied curricula in space exploration and intelligent robotic systems / APPLE

APPLE is *aimed to* adapt, modernize and restructure existing curricula in space exploration and intelligent robotic system; to develop new certified courses according to the new developments in the area, the labor market demand and the Bologna Process; to test innovated curricula and to disseminate the results. The planned curricular reform will focus on content, structure, teaching methods and use of new teaching materials with regard to the European modernization agenda for higher education.

The *mission of the project* is to introduce the applied educational program by reviewing/analyzing/upgrading the current curricula to recent advances in the target field; to develop, implement and accredit the new curricula inclusive B-learning and M-Learning; to modernize the existing and to establish the new equipped labs for effective education in frames of new educational program; retrain of academic staff/mentors in frames of new curricula; to conduct pilot teaching with the support of the stakeholders.

Updated courses within the framework of the project APPLE

SET – BA

1. **Intelligent robotic systems for space exploration** <- Space robotics

SET – MA (2 year)

2. **Optimization problems of spacecraft control** <- Celestial mechanics for space mission engineering
3. **Microprocessor technology on space systems** <- Development of space-grade embedded systems + Space electronics and remote sensing devices
4. **Digital processing of satellite data** <- Digital Signal Processing on Satellite Systems + Space electronics and remote sensing devices
5. **Modern satellite data processing packages** <- Processing and database creation for Ionosphere

IET-1 Space monitoring – MA (1,5 year)

6. **Application of GEONETCast for monitoring of environment of industrial regions** <- Processing and database creation for Ionosphere
7. **Basics of space management** <- Equipment and innovation strategy management

Updated courses within the framework of the project APPLE

IET-2 Spacecraft designing – MA (1,5 year)

8. Advanced microelectronics <- Advanced microelectronics: design of custom integrated circuits in CMOS technologies for space applications

IET-3 Mechanics of machines and manipulators, the creation of intellectual robots – MA (1,5 year)

9. Design and control of robots <- Combined robotic platform

10. Embedded processing - microcontrollers <- Embedded system and robotic education in a blended learning environment utilizing remote and virtual labs

11. Design of work of the humanoid robot <- Model based mechatronic systems modelling methodology in conceptual design stage

IET-2 Spacecraft designing – MA (1,5 year) **new subjects**

12. CAD/CAM/CAE design at space applications **-> CAD tools for design of systems on chip**

13. Spacecraft electrical system design -> **Electronic design and assembly of space systems**

14. Thermo-mechanical design of the satellites of micro- and nano- type **-> Energy efficiency of onboard systems and equipment**

Cooperation with Samara University

- **2015, December** – Associate professor of Samara University Kopenkov V.N. has read the discipline "Fundamentals of Remote Sensing" for master students
- **2016, February** – 4 master students of specialty "Space Engineering and Technologies" studied the discipline "Satellite power supply system" at Samara University
- **2016, July** – 6 master students of IET "Space Monitoring" have been training at the Institute of Additional Education of Samara University

# Visit of delegation from Samara University to KazNU on 01.11.2016

Scientific projects in KZ

- **Development of the hardware-software complex of a spacecraft and creation of the experimental sample of nano-satellite (2013-2015)**
  The purpose of the Project: to develop and build software and hardware complex and create an experimental prototype made by students from Kazakhstan.

- **Development of the attitude control system of remote sensing small satellites and small satellites for scientific purposes (2015-2017)**
  Goal of the Project: Development of mathematical and computer models of the attitude control system of small satellites for various purposes, upgrading of existing and the synthesis of new control laws, possible to be implemented on the planned remote sensing satellite and satellite for scientific purposes.

- **Establishment of the national scientific school on development of space engineering and technologies. Design, assembly and launch of the first nanosatellite of Kazakhstan (2015-2017)**
  The Program goal: Development of the base for professional training for the space industry of Kazakhstan, development of the technology of creation, assembly and launch of the small spacecraft.

Nano-satellite «Al-Farabi-1»

The first student nano-satellite in Kazakhstan was developed by students of our specialty «Space engineering and technologies».
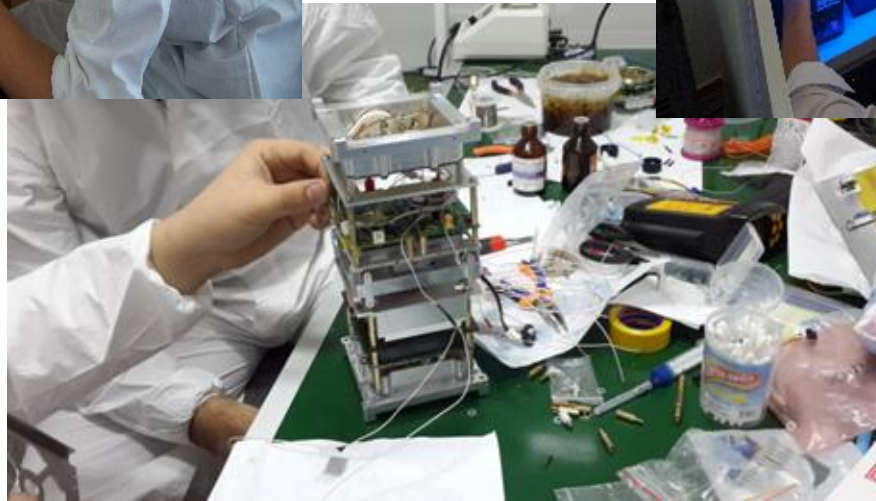
Submitted scientific projects for grant financing

- **Application of satellite altimetry data for the wave climate study of the Caspian Sea (with the participation of Professor Sh. Nakasuka, University of Tokyo, Japan)**
  Aims of the project: Determination of the main features of the wave climate of the North-Eastern part of the Caspian Sea and its influence on the state of the sea and the coast on the basis of the wave heights measurements. Identify the main changes of the wave climate of the Caspian Sea over the past 25 years. Obtaining a forecast of the state of the coastal regions of the Caspian Sea. Development of the recommendations for coastal building.

- **Control system design of the satellite formation motion for remote sensing of the Earth (with the participation of Professor T. Soomere, Tallinn University of Technology, Estonia)**
  The purpose of the project is development of the mathematical and simulation models of the motion control system for the satellite formations of the Earth remote sensing on the geostationary orbit to provide a real-time survey of the Earth's surface.

World Aviation and Cosmonautics Day with the support of the United Nations Information Office in Kazakhstan
12.04.2017

THANK YOU
FOR YOUR ATTENTION!