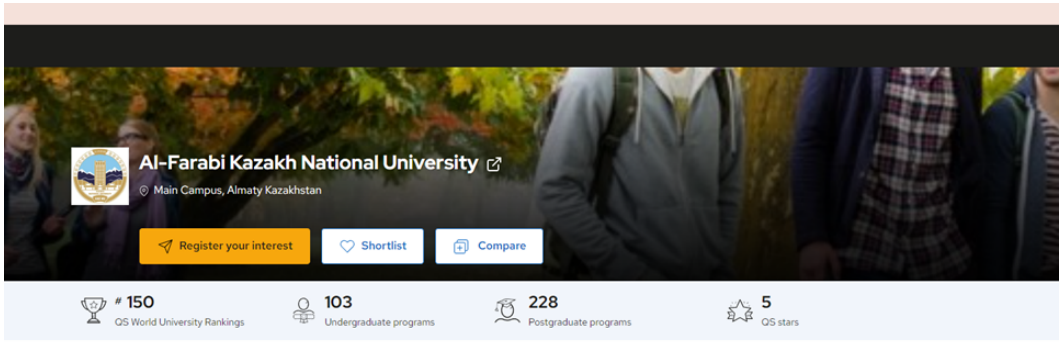
Implementation of the educational program on the specialty of "Space Engineering and Technology" in al-Farabi Kazakh National University: experience and sustainable development

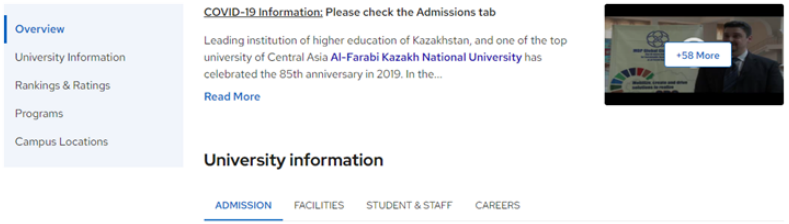
Zaure Rakisheva
Head of Department on Mechanics
al-Farabi KazNU

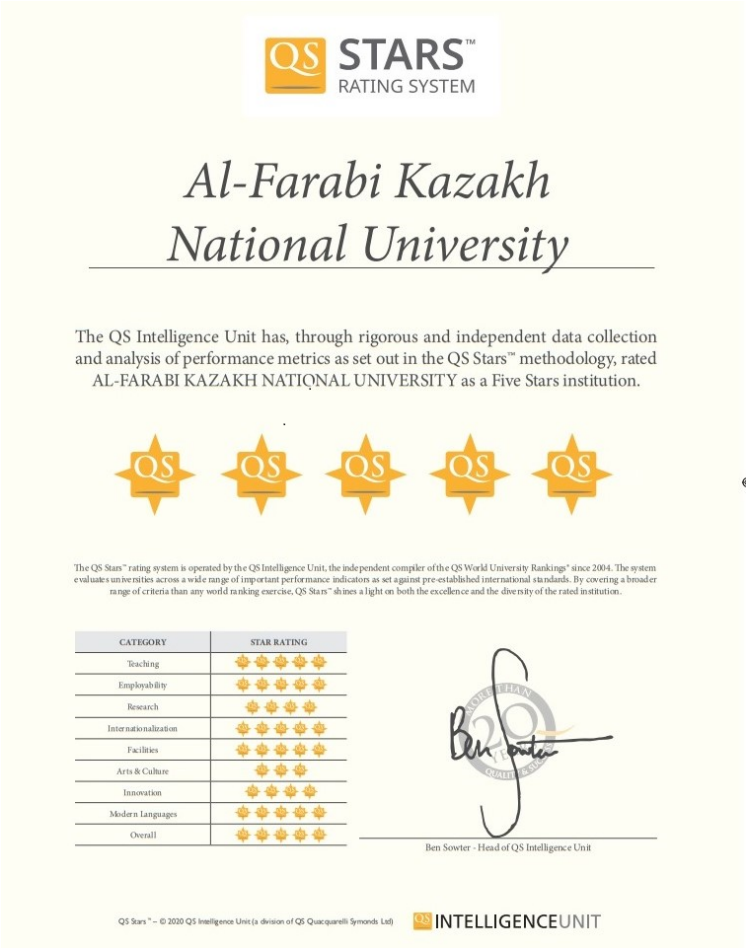
July 16, 2022

Al-Farabi KazNU in the QS World University Rankings

150 place in the QS WUR (2022) Five stars of Excellence







University profile: facts and figures

•**University Profile**

- **16** Faculties
- **67** Departments
- **32** Scientific Research Institutes and Centers
- 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 **40** researchers who received highest national awards of the Republic of Kazakhstan
- more than **40** laureates of State Awards of RK
- **40** laureates of the young scientists' awards
- **47** fellows of state scientific fellowships

• **Students profile**

- Enrolment of the University in both cycles amounts to more than 25 000 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:

Bachelor Program;

Master Program;

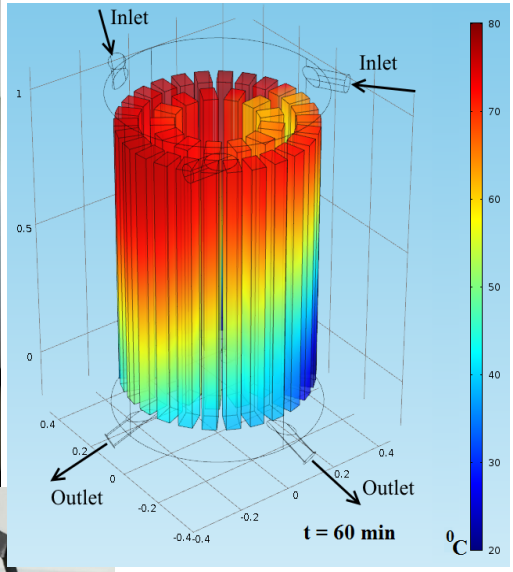
PhD Program.

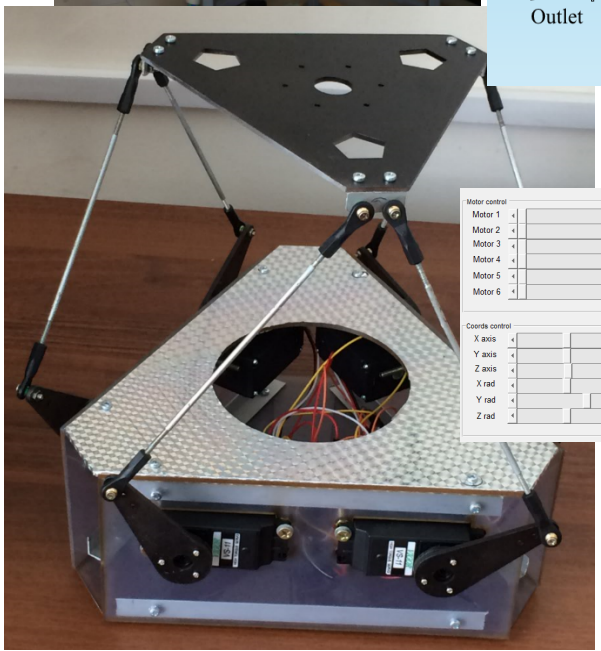
Main directions of development of educational and scientific activities:

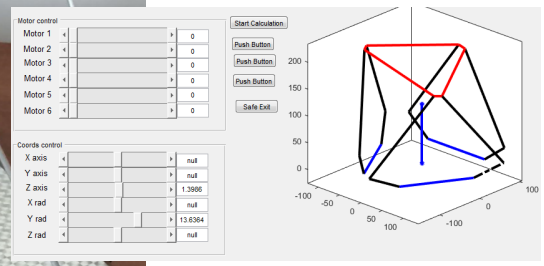
Theoretical and celestial mechanics

Fluid mechanics (plus renewable energy)

Mechanics of machines and mechanisms (plus robotics)







Education programs development

	1934	2010	2012	2013	2015-2017	2019	2021	2023
Mechanics	Bach Mast PhD	2-diploma Master Program (France)	Bach Mast PhD	Bach Mast PhD	Bach Mast PhD	Bach Mast PhD	Bach Mast PhD	Bach Mast PhD
Space Engineering and Technology		Bach	Bach Mast	Bach Mast PhD	Bach Mast Profile Mast PhD	Bach Mast PhD	Bach Mast PhD	2-diploma Master Program (in plan)
Robotic Systems						Bach Mast	Bach Mast PhD	2-diploma Master Program (in plan)

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».

At present we implement three levels of training in this specialty:

- Bachelor Program – since 2010;
- Master Program – since 2012;
- PhD Program – since 2013.

Profiled Master Program – 2015-2018

Two directions of the specialty development:

- Spacecraft development and motion control
- Space monitoring

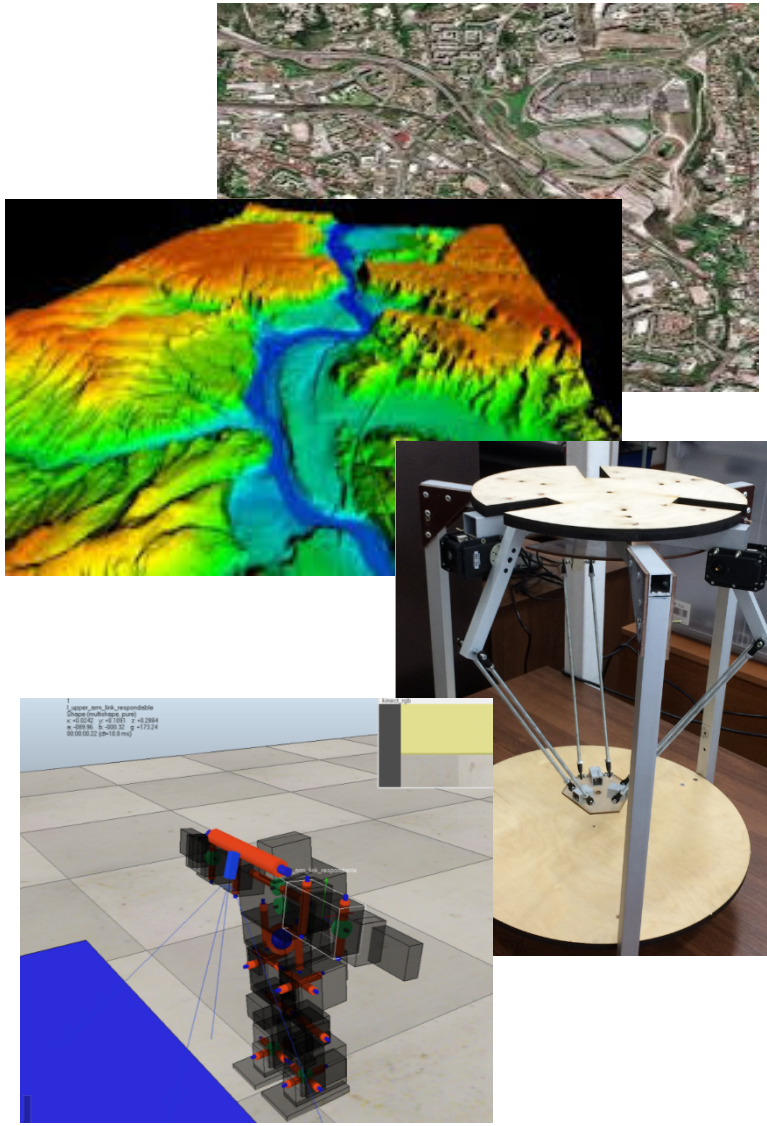
More than 100 defended masters, 2 PhD

Space engineering and technologies

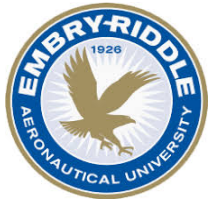
In 2015 by National Program of Innovative and Industry Development of RK (NPIID-2) new individual education trajectories «Information technology of space monitoring systems» had been opened within Master Program on specialty «Information systems» on Department on Mechanics.

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

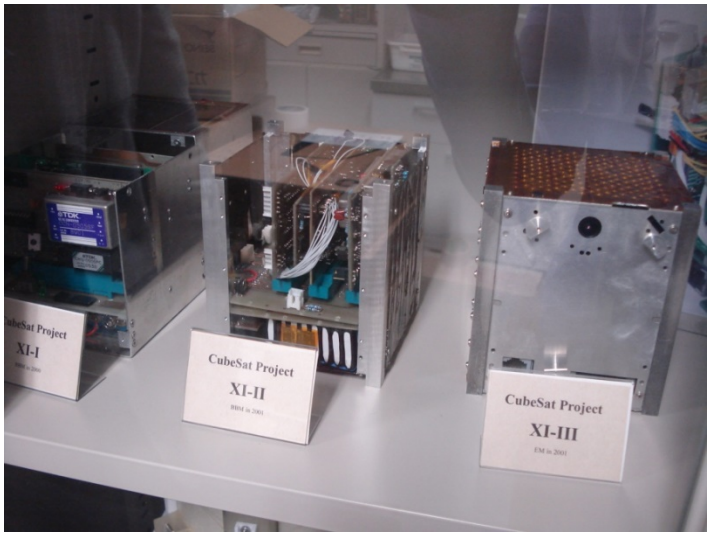
Within the NPIID-2 for enrollment 2016 the new IET was developed in addition «Design of the spacecraft».



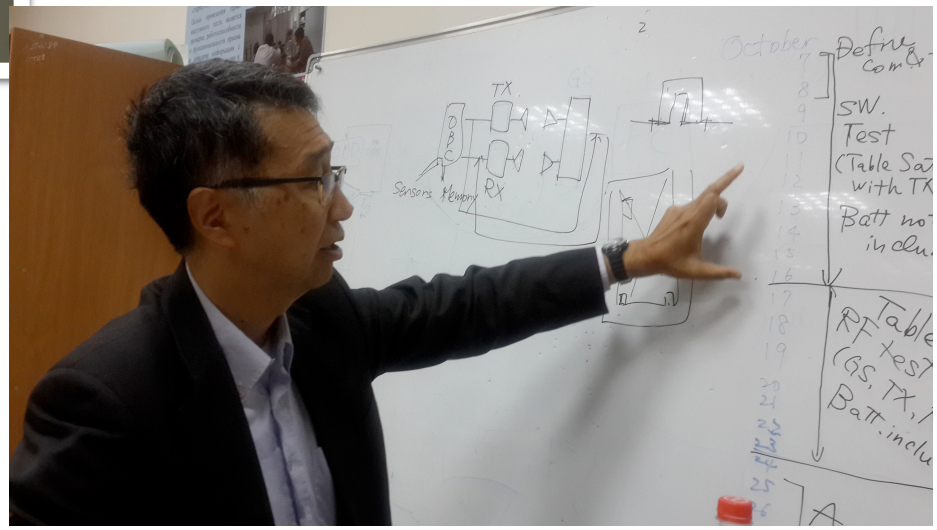
Foreign academic partners



International collaboration: Japan

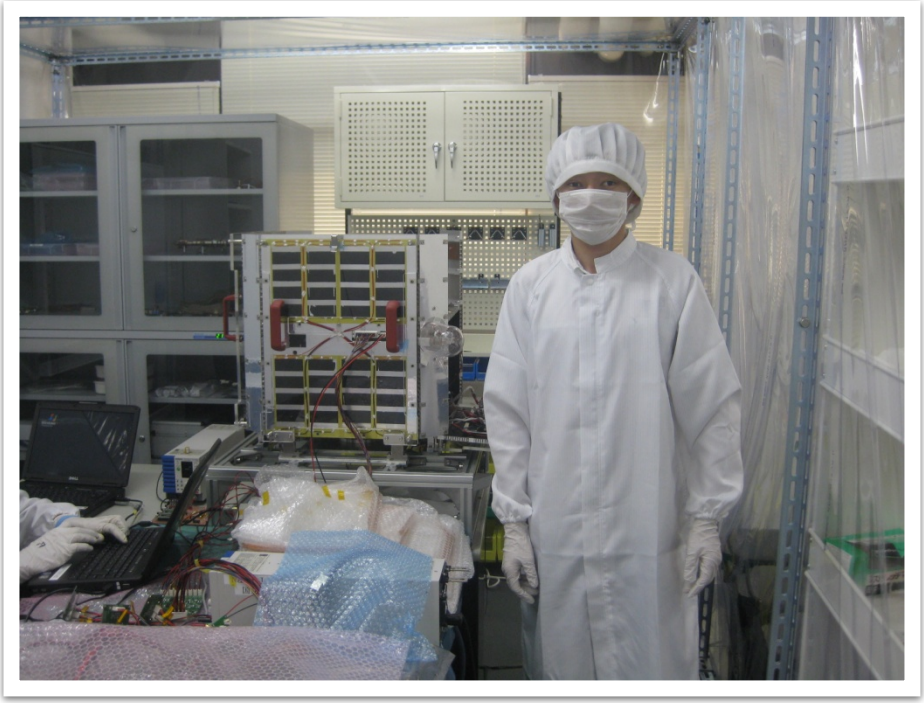


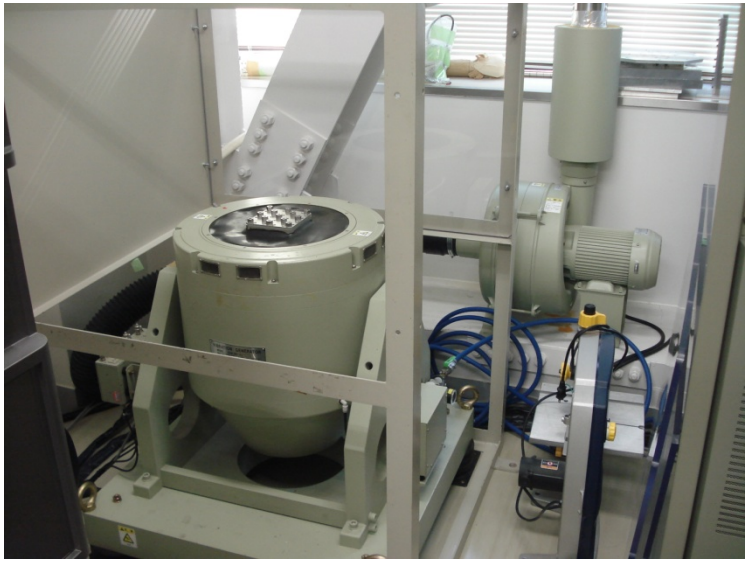
Since **2007** - prof. Shinichi Nakasuka (University of Tokyo), one of the well-known scientists in the field of the nano- and microsatellites' development, read lectures at al-Farabi KazNU



Reading lecture in October, 2016

International collaboration: Japan



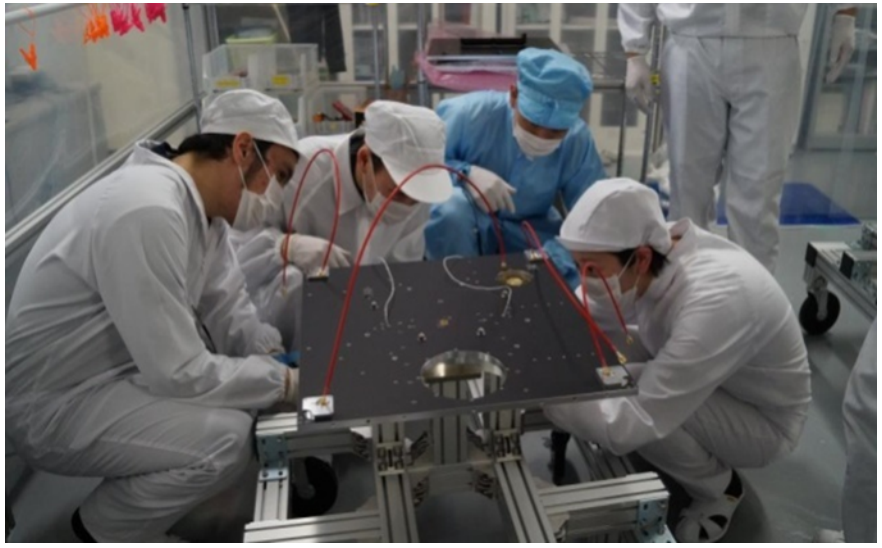


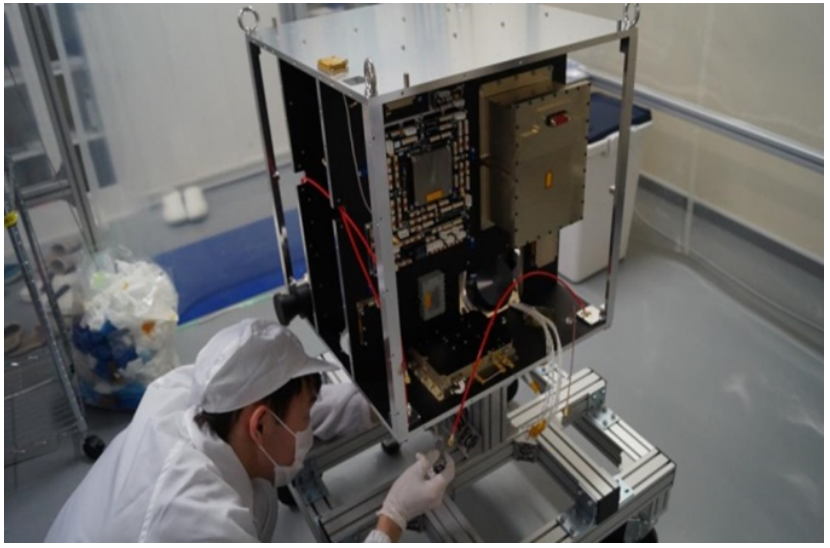
June-August 2010 – doctorial student K. Alipbayev passes internship in Laboratory of Intelligence Space Systems of prof. Sh. Nakasuka

Cooperation in the field of the satellite development

Vice-rector of KazNU T. Ramazanov with prof. Sh. Nakasuka from UT

Symposium on nanosatellites in 2013. Together with master students, passing the internship in UT





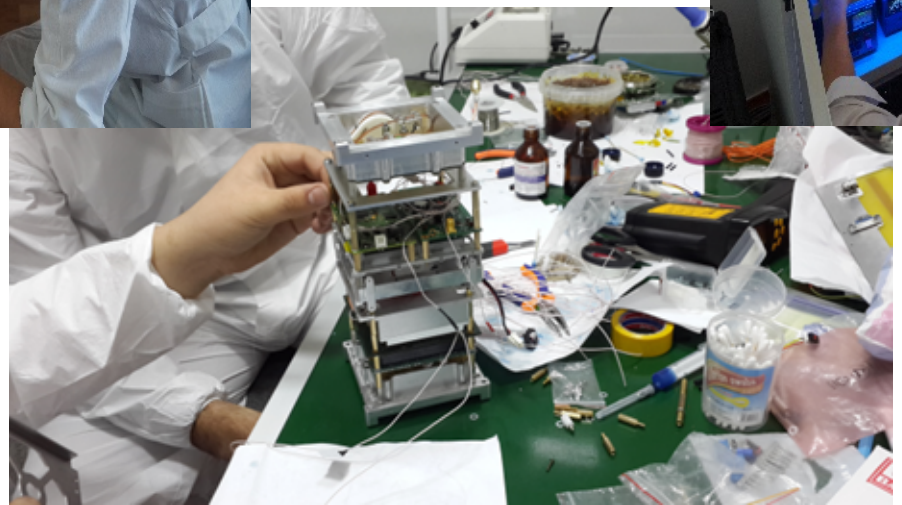
Master and doctorial students of KazNU on internship in Japan: installation and testing of the small satellite UNIFORM 2 (Kyushu Institute of Technolgy)

Scientific projects

- **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.
- **Control system design of the satellite formation motion for remote sensing of the Earth (with the participation of Professor Sh. Nakasuka, University of Tokyo, Japan) (2018-2020)**
  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.

Nano-satellites «Al-Farabi»

The first student nano-satellite in Kazakhstan was developed by students of our specialty «Space engineering and technologies» and students of faculty of physics and technologies.

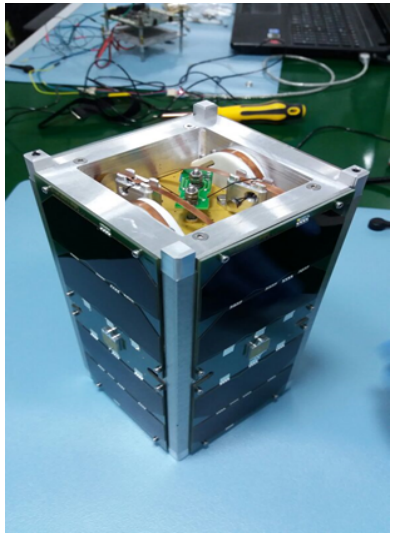


Development of the KazNU nanosatellites

together with the Techno park

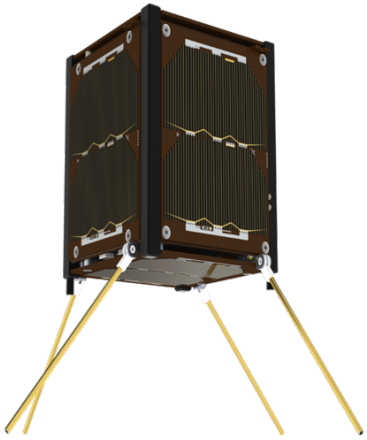
Al-Farabi-1

- type: 2U cubesat
- mass: 2.3 кг
- mission: educational (development of the communication system and power supply system)
- Launched at February 15, 2017 by PSLV from the Shriharikota



Al-Farabi-2

- type : 1U cubesat
- mission: development of the developed on-board computer
- Launched at December 3, 2018 by Falcon 9 of the SpaceX from California



International educational projects

Tempus

SESREMO

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

2014-2017

Co-funded by
the Erasmus + Programme
of the European Union

APPLE

Applied curricula in space exploration and intelligent robotic systems (APPLE)

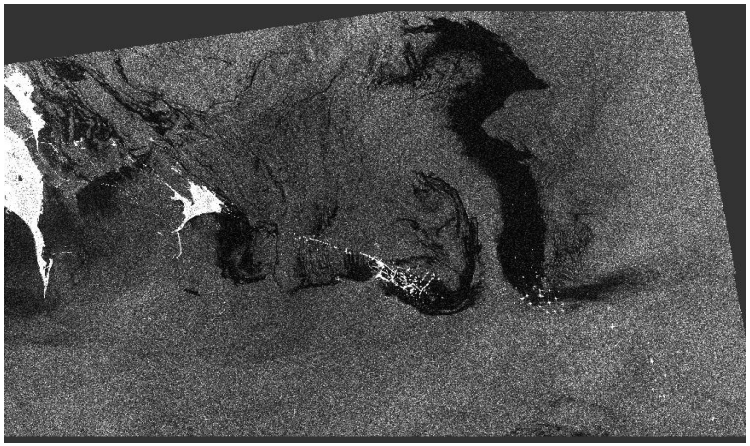
2016-2020

GEOCLIC

New Courses in Geospatial Engineering for Climate Change Adaptation of Coastal Ecosystems (GEOCLIC)

2021-2024

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

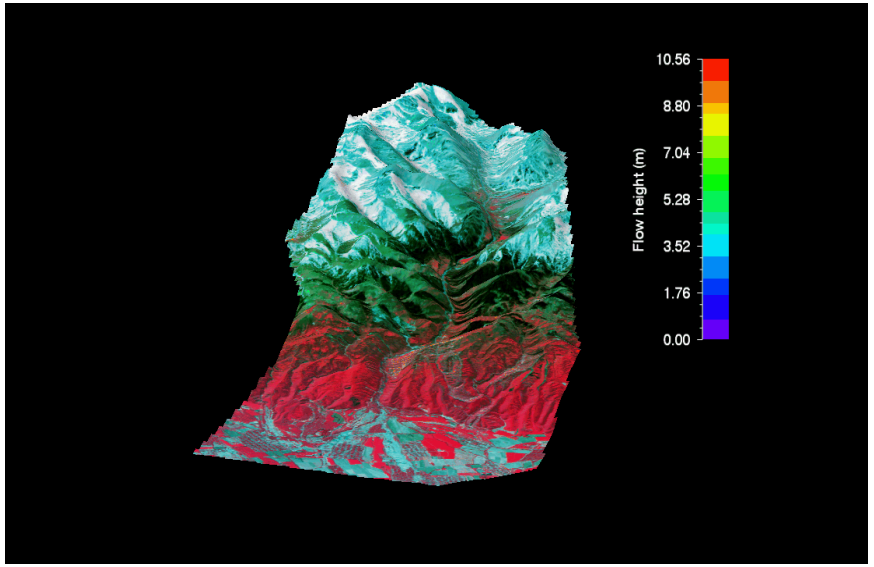


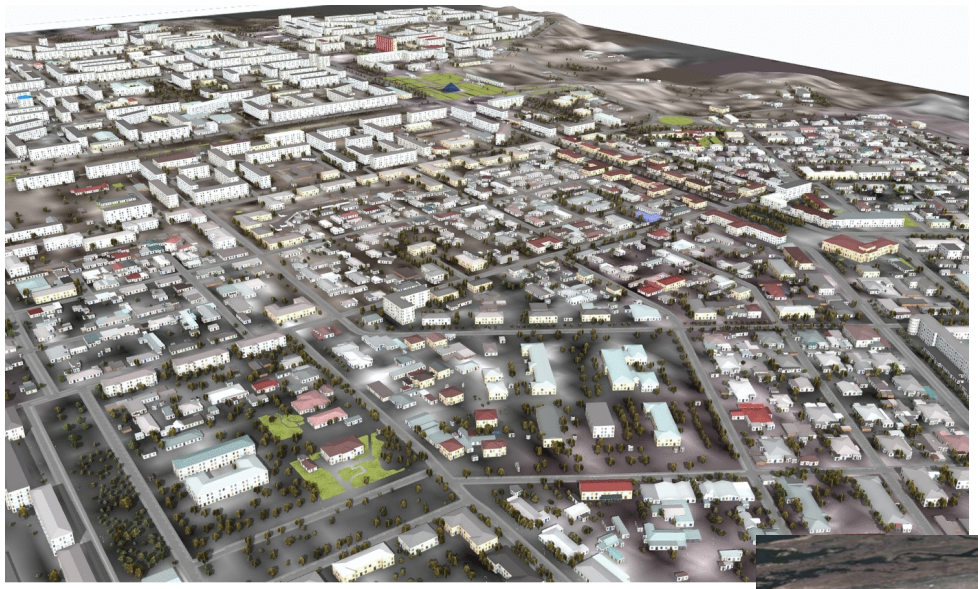
Satellite monitoring of oil in water reservoirs

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



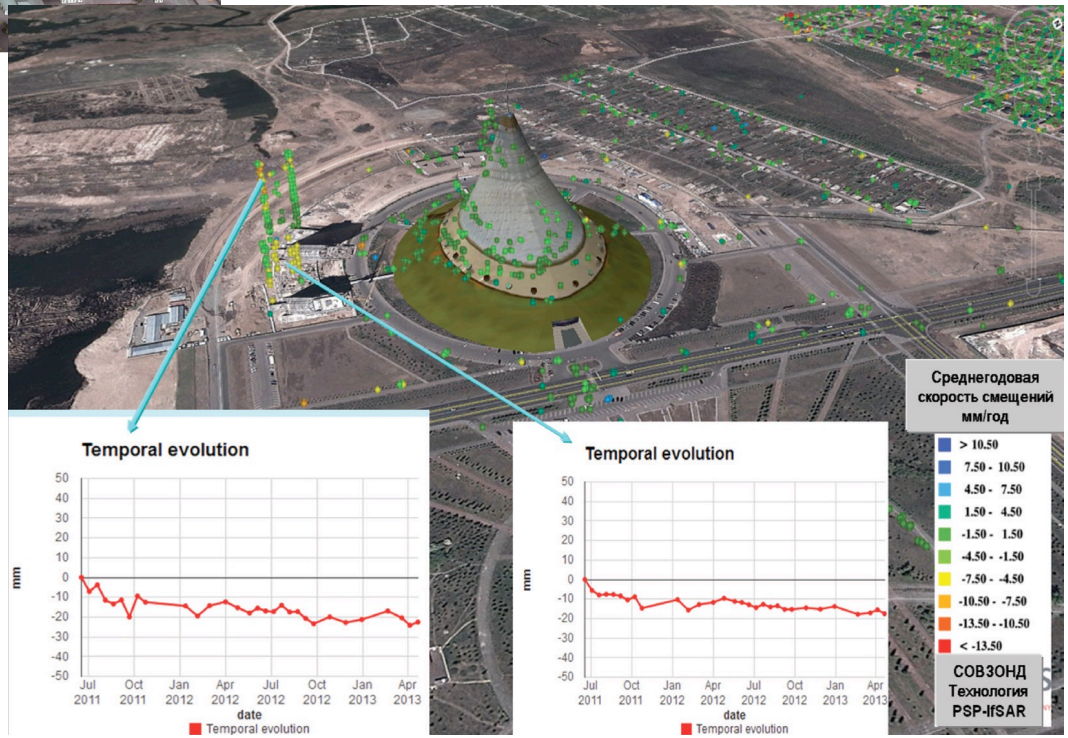


3D Zhezkazgan city

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

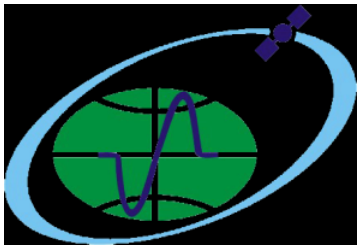
Vertical displacements of points of the Earth surface of the Astana city

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



Bases of the students' internship

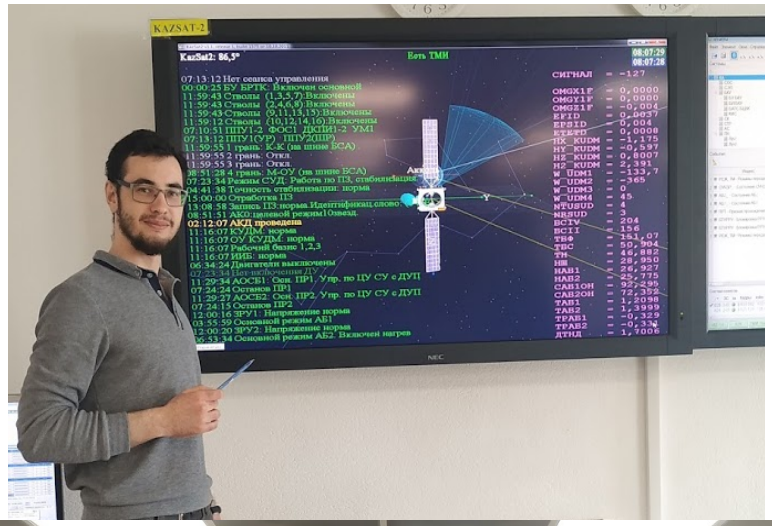
National Center of Space Research and Technology
Institute of Space Technique and Technology
Institute of Ionosphere
Fesenkov Astrophysical Institute
KGS Space Technologies
KazGeoCosmos
Ghalam LLP
Republican Center for Space Communications, «Akkol» and «Kokterek»



FESENKOV
ASTROPHYSICAL
INSTITUTE

Internship of the students at the Republican Center for Space Communications, Akkol, 2019

(R. Pilpani, D. Komarova, K. Pangireyeva)



Summer school in the Technical University of Berlin

Internship of master students in **S. Korolev Samara State University**

Participation in the «University Skills Competition» in Moscow, Russia, November 26-29, 2019

Students of the 4th year of the EP “Space Engineering and Technology” E.Manazhanov, E.Kambarbayev. N.Chikrizov: installation of the satellite model and testing of the subsystems.

Meetings with the Kazakh cosmonauts Talgat Musabayev (June 2014) and Aidyn Aimbetov (September 2015)

Infrastructure of al-Farabi KazNU

- **Center of Remote Sensing** is opened in 2017. Specialists from China Academy of Sciences set the virtual station SATSEE in 2018.
- **Center of flight control** is created in 2018 for communication with the nanosatellite «al-Farabi – 2», and for the future satellites of KazNU.


UNISEC
University Space Engineering Consortium
KAZAKHSTAN
https://www.facebook.com/UNISECKZ/
THANK YOU
FOR YOUR ATTENTION!