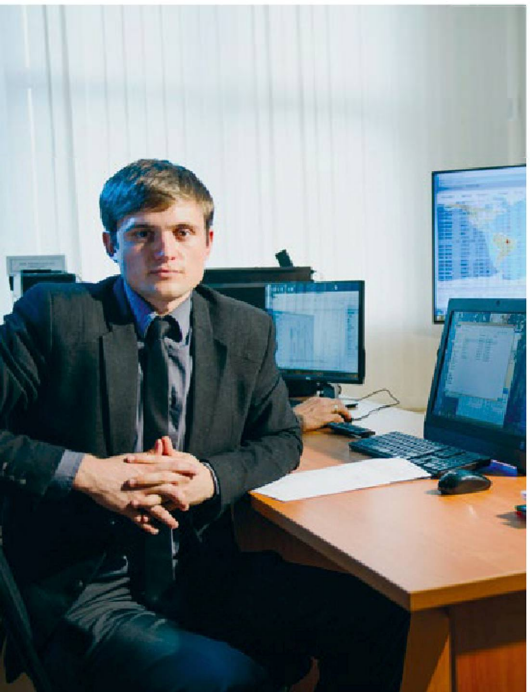
SAMARA UNIVERSITY

Group of small-size spacecraft of the series AIST

Samara National Research University named after Academician S.P. Korolev since 1957 has been designing and building aerospace equipment, the strategic trend in research and training of specialists.

The university has formulated a world-class, unique research and educational complex, which involves the students directly in all stages of development, creation and testing of spacecraft.



The unique, distributed space laboratory with ground and space segments is based on:

1 Spacecraft orbital group

An operating orbital small-size spacecraft (SSC) group of the Aist series for research and educational purposes, created by the university with its strategic partner SRC Progress JSC.

This group has been operating since 2013 and is part of the distributed space laboratory with ground and space segments.

There are two first generation Aist SSC currently in orbit along with the Aist-2 Earth remote sensing SSC. All of these craft were created by the SRC Progress, with the active participation of scientists and students from Samara University.

2 Small-size spacecraft testing complex

The SRC Progress has set up within the university a production and testing complex for high-tech production and development of Earth remote sensing (ERS) SSC, equipped with various types of special-purpose equipment.

3 Nanosatellite testing centre

The Centre for Testing and Comprehensive Development of Nanosatellite Systems of the CubeSat 1U-3U standard and their subsystems is a group of laboratories resolving a broad set of tasks.

4 Control complex

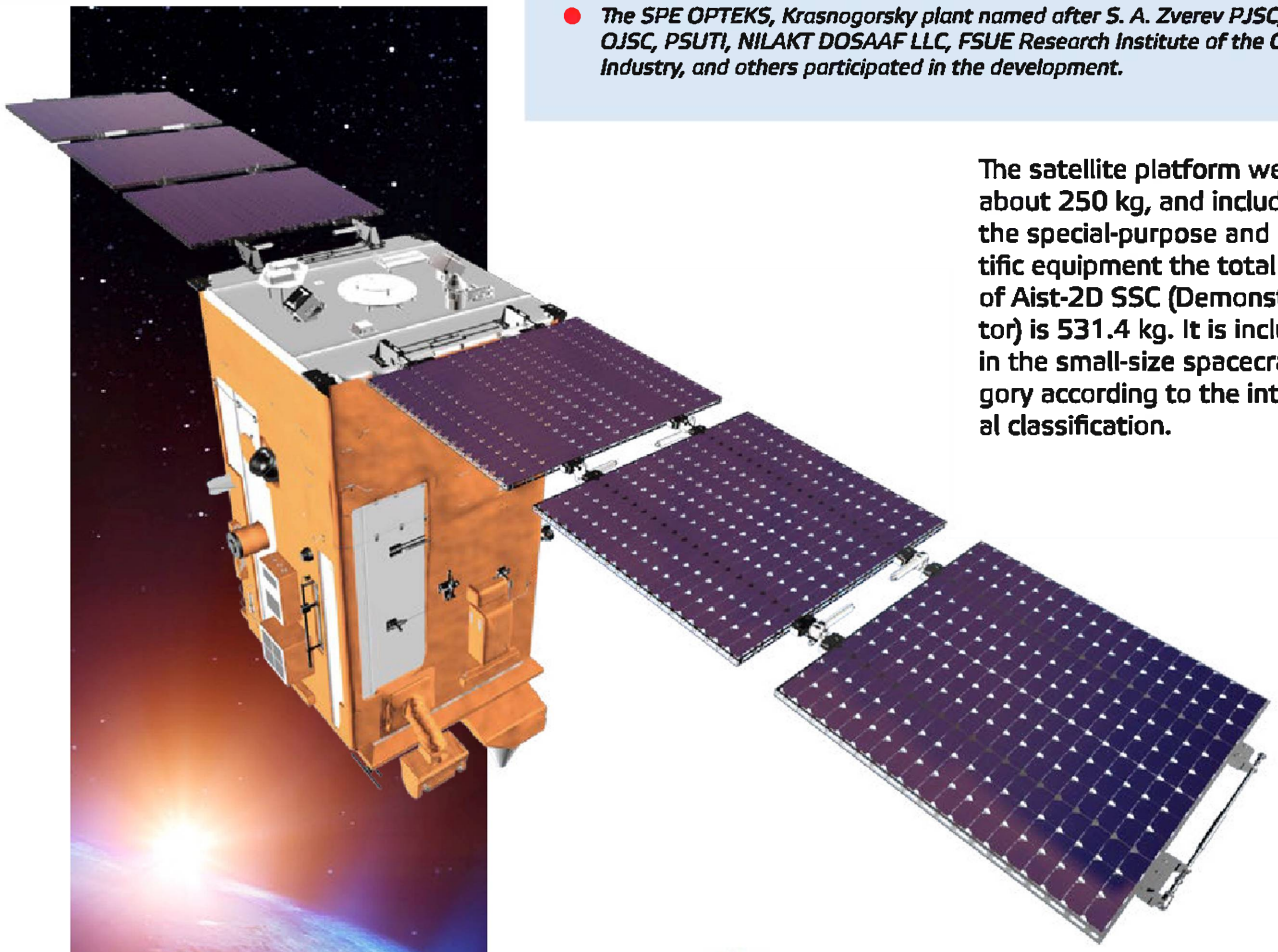
The ground-control complex of SSC grouping of the Aist series (GCC SSC), which operates jointly with the Samara Data Acquisition and Processing Centre of the SRC Progress.

Aist-2D
small-size spacecraft

The Aist-2D optoelectronic SSC is designed for Earth remote sensing, scientific experiments and developing and certifying new special-purpose and scientific equipment to support systems and their software.

Aist-2D was launched on April 28, 2016 (during the first launch from the new Russian Vostochny Cosmodrome) with the Lomonosov satellite and the SamSat-218 nanosatellite, developed by the Samara students.

- *The Aist-2D SSC was developed by the scientists from Samara University and specialists from SRC Progress under the project "Creating High-tech Observation SSC Using Hyperspectral Equipment for the Socioeconomic Development of Russia and International Cooperation" to be carried out by Decree No. 218 of the RF Government of April 9, 2010.*
- *Samara University and SRC Progress previously cooperated in developing, fabricating and successfully launching two small-size Aist spacecrafts, which are currently orbiting. Some of the technical and software solutions developed on Aist SSC are being used on the Aist-2 satellite.*
- *The SPE OPTEKS, Krasnogorsky plant named after S. A. Zverev PJSC, Saturn OJSC, PSUTI, NILAKT DOSAAF LLC, FSUE Research Institute of the Cable Industry, and others participated in the development.*



The satellite platform weights about 250 kg, and including the special-purpose and scientific equipment the total weight of Aist-2D SSC (Demonstrator) is 531.4 kg. It is included in the small-size spacecraft category according to the international classification.

Aist-2D special-purpose SSC

Multispectral optoelectronic equipment

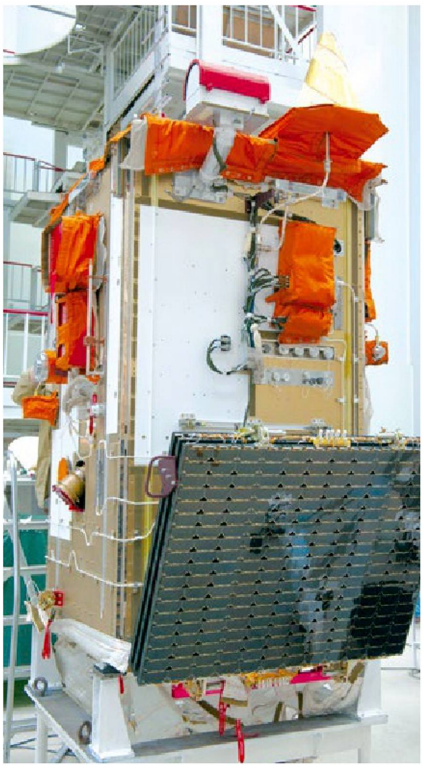
The primary special-purpose Aist-2 SSC is a wide-span, multispectral optoelectronic craft (OEC) of Aurora visibility range, developed and manufactured by Krasnogorsky plant named after S. A. Zverev, Shvabe Holding.

It has a distinctive combination of high resolution and enhanced range band with minimum mass-dimensional characteristics.

From an orbital altitude of 490 km, the Aist-2D should provide resolution of 1.48 m in panchromatic mode and 4.5 m in multispectral mode in a 39.6 km-width band.

IR-range thermal equipment

The IR-range thermal equipment of Aist-2 SSC, which was the first to use microbolometric photo detectors without cooling, will not only produce night photographs, but also develop the technology for small fire foci detection.



Innovative radar for passive Earth location

The special-purpose equipment includes an innovative radar set developed for passive Earth location in a new R-range of frequencies (432-438 MHz). The scientists plan to use it for possible space observation not only of visible surfaces, but also subsurfaces and structures and objects camouflaged by vegetation. Povolzhskiy State University of Telecommunications and Informatics developed the radar (PSUTI).

By working in tandem with the ground equipment, the radar observes objects, camouflaged by tree leaves or other vegetation with spatial resolution up to 5 metres. The penetration depth under the Earth's surface is considerably greater than the radar sets currently in orbit and depends on the soil moisture content and structure. It ranges from tens of centimetres in ordinary soil to tens of metres in the desert.

The Aist-2D radar is dependent on ground reception points for the time being. But the scientists hope to use it to develop new Earth remote sensing technologies to create a future (monostatic) space radar with better resolution, which does not rely on ground equipment.

Aist-2D
SSC scientific equipment

The satellite holds six sets of scientific equipment created by Samara University, Institute of Space Instrument Engineering, scientists, students and post-graduate students:

1 DMS-01 mass-spectrometric sensor

The DMS-01 mass-spectrometric sensor analyses the SSC's own external atmosphere (gas environment) to study the impact of space factors on the quality of scientific and technical experiment and the satellite's aerodynamics.

2 DCh-01 particle sensor

The DCh-01 particle gage studies the gradual destruction of surface component samples in the space environment.

It studies the degradation of surface components by high-speed particle streams, and also the impact on the studied samples of such factors as photon streams, ultraviolet radiation and the satellite's own atmosphere.

The scientists analyse the effect of electrons and protons on the memory microcircuits, microcontrollers, antennas, check their radiation resistance and efficacy of their installed protection.

3 Magnetic motion-control system

The magnetic motion-control system of the spacecraft (kinetic momentum reset) solves satellite spatial stabilisation tasks.

4 KMU-1 micro-acceleration compensator

The KMU-1 micro-accelerations compensator monitors the status of the equipment and compensates for on-board rotary micro-accelerations in the low-frequency spectral range. By operating alternately with the standard magnetic motion-control system, the KMU-1 orients the satellite by the Earth's magnetic field vector.

5 Meteor-M set

The Meteor-M set studies micrometeorites and space debris particles.

History

Mid 1980s

Samara University (previously Kuibyshev Aviation Institute (KuAI) began to develop its own spacecraft back in the mid 1980s.

The first KuAI satellites were launched in 1989. The spherical craft Pion studied the upper atmospheric layer densities. A total of six satellites in this series were launched in 1989-1992.

2006

A group of students from Samara University (it was then SSAU) in 2006 initiated a project to create the small-size university spacecraft AIST. The craft was developed in cooperation with the SRC Progress with the support of the Samara Region Government.

2013

After blasting o fffrom the Baikonur Cosmodrome on April 19, 2013, the Soyuz-2.1a rocket launched the Aist SSC into orbit as one of the payloads with the BION-M No. 1 satellite.

The new light-class Soyuz-2.1v launched the injection unit Volga with second Aist SSC on December 8, 2013.

2016

On April 28, 2016, during the first launch from Vostochny Cosmodrome, the first AIST-2D SSC was put into orbit together with the scientific satellite Lomonosov and the nanosatellite SamSat-218. The spacecraft were launched using the Soyuz-2.1a launch vehicle and Volga rocket booster, created by Samara SRC Progress.

The first series AIST SSC are designed for educational, scientific-technical and experimental tasks, including:

- measurement of the Earth's magnetic field and development of a system for measurement and compensation of small spacecraft micro-accelerations;
- study of micro-gravitational problems;
- study of the behaviour of natural and artificial high-speed mechani cal particles;
- experimental space development of promising types of solar galli um arsenide arrays based on nanotechnologies.

Both Aists are currently functioning successfully in orbit. The SRC Progress and GCC SSC of the Samara University are receiving information and students and post-graduate students are processing it.

Outlook

Aist-2 is a considerably broader project than mere development of a specific spacecraft.

The satellite was originally designed as a universal space platform to monitor the Earth's surface. It allows different types of special-purpose equipment to be used for various tasks. Any camera, operating in the optical or IR-range, or hyperspectral equipment may be installed on the Aist-2 SSC, and the satellite correspondingly modifies its functioning.

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