Main research and development work completed in 2013 and ready for implementation

Multi-sensor automated technology for forest burnt area mapping over Russia based on satellite data

Automated technology of forest burnt area mapping and assessment over the territory of Russia is developed based on joint usage of different spatial resolution data acquired by MODIS and Landsat remote sensing satellite systems. The technology includes aggregation of three types of burnt area assessment, which are different by rapidness and accuracy. Most rapid burnt area detection is carried out on the basis of satellite measurements of Earth's surface temperature with spatial resolution of 1 km. The further burnt area assessment correction is performed based on analysis of surface spectral reflectance as measured by satellite sensor of 230 m spatial resolution. Final and most precise burnt area assessment is achieved through the use of satellite data with 30 m spatial resolution. The technology is expected the aggregation of different data by using the most accurate assessment at present. On the basis of developed technology 9.9 mln ha of the area burnt over the territory of Russia in year 2013 has been mapped, including 4.8 mln ha of forested area. The technology is developed as a part of forest fire monitoring information system ISDM-Rosleskhoz operated by Russian Federal Forestry Agency.

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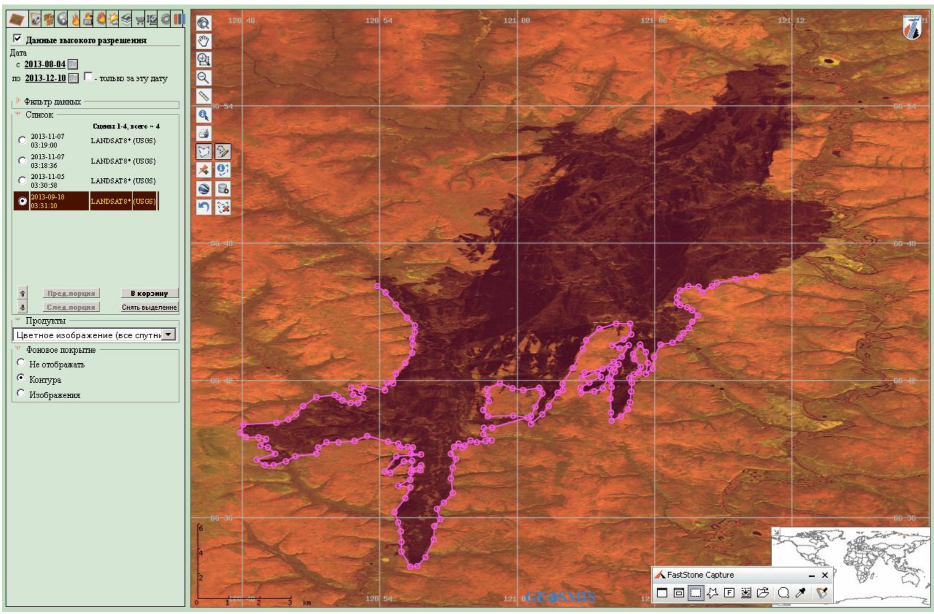

Web interface for burnt area mapping using Landsat data

Stellar Tracker

In 2013 IKI RAN together with the NPK “Electrooptics” completed the phase of the five-year research on studying the ways to build a stellar inertial navigation system (SINS) for aviation applications. SINS is based on the high-precision strapdown inertial navigation system and a stellar tracker. The strapdown inertial navigation system consists of high-precision laser gyros and precision quartz accelerometers with the integrated GLONASS/GPS signal reception equipment. The stellar tracker has been designed to determine the attitude control parameters by the celestial bodies (stars and the Sun) and to correct strapdown inertial navigation system drift. Complexity of these systems, in particular, consists in the need to track the stars and to determine the attitude control parameters around the clock, including the daytime.

SINS provides for measuring angles in the geographic coordinate system with an accuracy of several angular seconds, as well as the location coordinates within tens of meters in a fully autonomous flight mode, even in the absence of signals from the GLONASS/GPS navigation satellites. Similar systems are needed for the construction of a number of high-precision airborne weapons systems. SINS for the aviation applications had been developed in the Soviet Union and the United States, starting since the 1980s. They used astrocorrectors with a device for guiding the brightest stars. IKI RAN has shown the ability to create stellar tracker without the guidance device. These newly developed stellar trackers allow tracking a group of stars and identifying the triaxial orientation parameters, including under daytime lighting conditions and the aircraft dynamics. Elimination of the mechanical guidance device provides for improving both the accuracy and reliability, as well as reducing the weight.

As a part of the research application the cooperation created all the SISN components. Fig. 1 shows the SINS layout created on the basis of the astronomical camera. Fig. 2 shows the first engineering prototype of the stellar tracker. Fig. 3 shows the SINS arrangement in the future navigation systems, which provides the round the clock determination of the triaxial orientation with an accuracy up to units of angular seconds. Similar SINS are considered for integration into the “Almaz-Antey”, Tupolev and Su-34 aircraft.

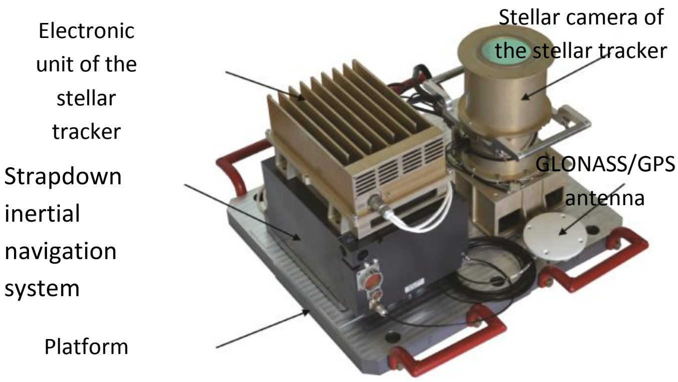

Fig. 1 SINS layout

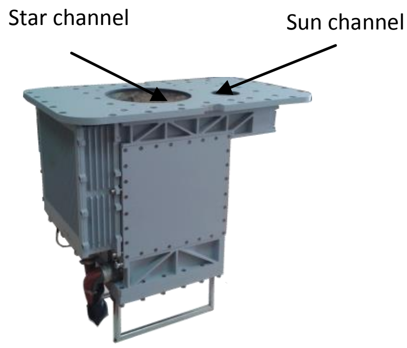

Fig. 2 First engineering prototype of the stellar tracker

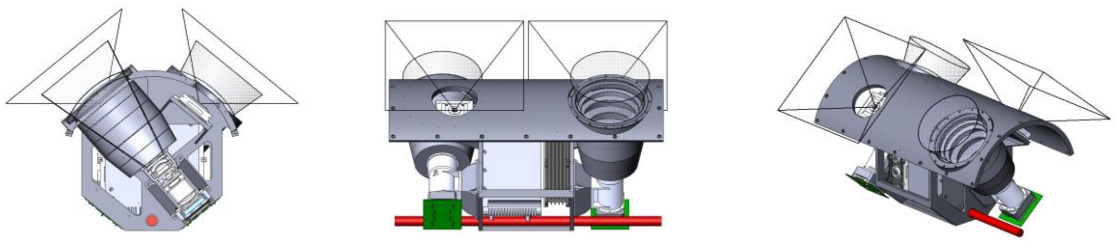

Fig. 3 SINS arrangement in the future navigation systems

Developers :

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Scientific and technical materials:

1. Technical project “Yuvelir”. The Stellar Tracker (AVU). An Explanatory Note, 2011.

2. Technical project “Drotik”. The Stellar Tracker (AVU), 2013.

Very long baseline radio interferometry - VLBI

The system «Quasar» included to the European VLBI network (EVN). IPA RAS and IKI RAS equipped radio telescopes of the system by receivers at 18 and 1.35 cm wavelengths and begin regular VLBI observations of maser sources in the hydroxyl lines in polarized emission. The VLBI data is processing on IPA correlator, the radio-imaging of objects is processing in IKI. The images in right and left hand circular polarization are obtained. The images of gas dust complex W3 OH are shown with resolution 0.1", Fig.1. The fine structure of individual components is obtained with resolution reaching interstellar scattering around 2 mas. The active regions are discovered, which correspond to discs and jets — the early stage of star formation. The identification of sources in left- and right-hand circular polarization was conducted. The Zeeman splitting is measured, which corresponds to the magnetic field around 7.6 mGs. The few compact objects are visible only in one of polarizations.

The regular observations are continuing. Including pulse emission of the Crab nebula pulsar at 18 cm wavelength, with participation of EVN radio telescopes.

The test observations with at «Quasar» system, with participation of European radio telescopes at wavelength 1.35 cm are finished successful. The Orion KL maps is obtained at water vapor maser emission.

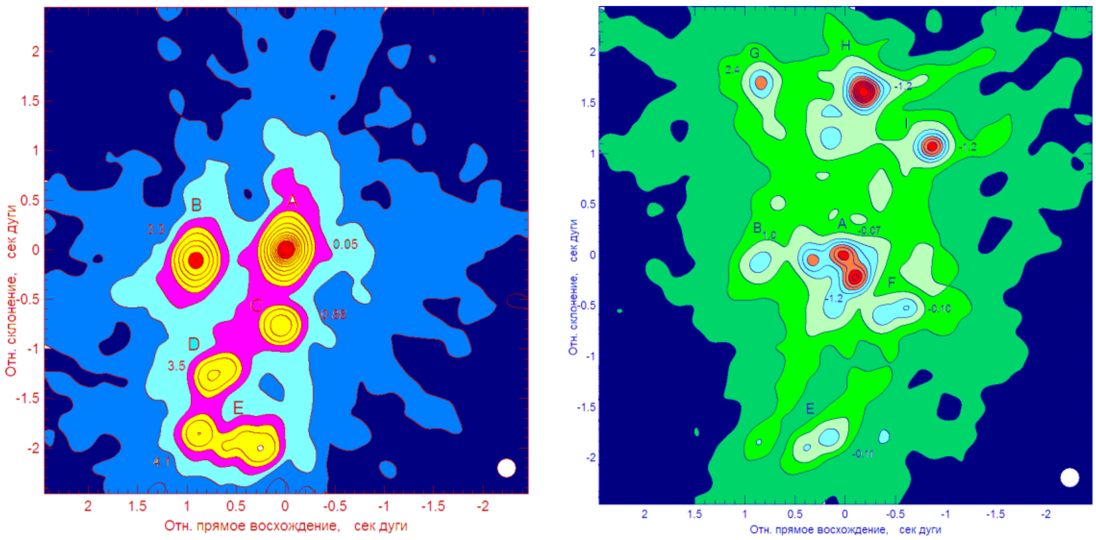

Fig.1. Radio maps of W3 OH in right- and left-hand circular polarizations, hydroxyl line λ=18 cm.

Publications

1. L. I. Matveyenko , A. V. Ipatov, V. A. Demichev, and A. E. Melnikov «Structure of the Object W3 OH in Hydroxyl Maser Lines» // Astronomy Letters, 2014, Vol. 40, No. 2–3, pp. 95–110.
2. A.V. Ipatov, L.I. Matveyenko, V.A. Demichev, A.G. Mikhailov, A.E. Melnikov, E.Ju. Khvostov. Complex Quasar-KVO - VLBI observations of maser sources. Contribution on conference VAK-2013. Works of IPA RAS. In print
3. A.V. Ipatov, V.A. Demichev, V.V. Mardyshkin, A.E. Melnikov, A.G. Mikhailov, I.A. Rakhimov, M.A. Kharinov, E.Ju. Khvostov, A.E. Volvach «The development of «Quasar - KVO» complex for astrophysical research on wavelength 18 and 1.35 cm. Works of IPA RAS. In print.
4. A.E. Melnikov, V.A. Demichev, A.G. Mikhailov, M.A. Kharinov, E.Ju. Khvostov «The conduction of radiointerferometric observations of maser sources on «Quasar - KVO» complex. Contribution on conference VAK-2013, Works of IPA RAS. In Print.
5. A.V. Ipatov, L.I. Matveyenko, A.G. Mikhailov, A.E. Melnikov, M.A. Kharinov «Observstions on astrophysical programs with radiointerferometric complex «Quasar-KVO», contribution on conference VAK-2013.