ABSTRACTS

Problems in the remote monitoring of global variations in the Earth atmosphere gas components

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Observation data on the global variations in the planet's optical characteristics are reviewed. Climate variations and ecological conditions of the Earth's atmosphere are discussed. The spectrophotometric method for monitoring the chemical composition of the atmosphere is described in detail. Observations in the thermal spectral region are demonstrated to be more advantageous. A small-sized vibration-proof Fourier spectrometer for the region 3—10 μm with a spectral resolution of 2 cm^{-1} is described. It can be used in stationary and field conditions, and on board artificial Earth's satellites as well. The spectrophotometric method is shown to be promising in the global and local monitoring of gas pollutants in the Earth atmosphere. As an example we give lower boundary estimates for relative concentrations (with respect to CO_2) of ten atmospheric gas components.

Radiometric aperture synthesis system for remote sensing of Earth's natural resources from space. I. Potentialities

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Microwave remote sensing from space provides a possibility of measuring some parameters important for understanding the environment of the Earth on the global scale such as sea surface temperature, ocean salinity, soil moisture, and sea ice concentration. However, realizing the full potential of passive microwave remote sensing from space requires putting relatively large antennas in space. Antenna size is the factor limiting the implementation of L-band radiometers in space to measure soil moisture, and it is also an important factor limiting the development of a microwave sensor to fill the gaps created by clouds in present-day visible and infrared sounding of the atmosphere. A possible means of overcoming this size limitation is to use aperture synthesis. This is a technique in which correlation receivers are used to coherently measure the product of the signal from pairs of small antennas with many different antenna spacings during a relatively large time of receiving radiation from pixel of surface by antennas. One can obtain very high resolution maps of a source by taking measurements with relatively small antennas with different baselines. The purpose of this paper is to develop an algorithm for radiometric signal processing and expressions for the map resolution and sensitivity.

Radiometric aperture synthesis system for remote sensing of Earth's natural resources from space. II. Digital processing of signals

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Suboptimal algorithms were developed for the digital processing of narrow-band and wide-band signals in radiometric aperture synthesis systems, functional diagrams of the corresponding processing devices are given. These devices are sufficiently simple, and their quality characteristics are close to those which can be theoretically attained. An algorithm for noncoherent accumulation of images is discussed, it allows the sensitivity of radiometric systems to be improved substantially without any additional complications in the equipment.

Investigation of the blistering and flecking effects materials of outer space factors on space optics

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At present a variety of optical devices are being developed for monitoring the environmental conditions in the outer space. This requires investigation of the effects of space factors (SFs) on materials and scale models of optical devices. The authors have studied the effects of SFs on the scale model of an infrared telescope and its components (the lens and the baffle made of various materials). These studies were made on a simplified model of the infrared telescope. The scale model was irradiated under conditions quite similar to those of the outer space. Combined $p^+ + e^-$ irradiation was carried out with the energy E = 150—200 keV, a total fluence of 10^{16} cm^{-2} (equivalent to a year), as well as irradiation of the model with an artificial Sun and by VUV rays ($\lambda\lambda$ 5—2500 nm). The structural and optical properties of the mirrors were investigated. The blistering effect was revealed, i. e., formation of a defect structure consisting of craters on the optics surface under bombardment by protons of the artificial and natural radiation belts of the Earth. Irradiation of the materials with 150—200 keV protons is absorbed by a 2 μm layer. Within this layer, protons recombine with electrons of the materials ($p^+ + e^- \rightarrow H$) with formation of hydrogen atoms, e. g., the yearly dose of absorbed particles is D = = 10^{16} cm^{-2}. As the irradiation dose increases, hydrogen is accumulated in spherical cavities. When the hydrogen pressure in the cavities becomes higher than the material strength, the material fails and hydrogen leaves the cavities, i. e., blistering takes place. The surface layer is thus eroded. A complicated structure appears on the surface as crater-like hemispherical defects 2—5 μm in diameter distributed uniformly. It has been shown experimentally that the proton fluence at which such defect structures form is $6 \cdot 10^{15}$ cm^{-2}, approximately equal to the annual equivalent dose. These defects, changing essentially the material surface properties, cause, in particular, decrease in the reflectivity both in the visible and the IR ranges.

Investigation of some features of flight dynamics and the cause of scattering of launching-vehicle separating parts

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Topical problems in the dynamics of LV separating part (SP) descent in dense atmospheric layers are investigated by the statistical testing method. Special features of its angular oscillation, their influence on the flying range and on the mechanism of scattering of SP dropping points are also analysed.

Expert system for creation and optimization of aerospace materials

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We describe an expert system for creation of new materials for space applications. The system automatically constructs the knowledge base using the methods of decision trees based on a modified ID3 algorithm and decision lists.

Nonlinear mechanism of electromagnetic radiation generation in cosmic plasma

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Parametric three-wave interaction of upper hybrid waves with kinetic Alfvën waves and electromagnetic waves (along and across the ambient magnetic field) is studied using two-fluid MHD. A nonlinear dispersion equation for the coupling waves and the growth rate of the parametric instability are found. We use our theoretical results for explaining observations of satellites in the magnetosphere. It is shown that electromagnetic waves both along and across the ambient magnetic fields can be generated as a result of the upper hybrid wave decay instability. It is also shown that the left-mode electromagnetic wave will be generated more efficiently than the ordinary electromagnetic wave. These parametric processes can also occur during solar flashes and in the magnetosphere of Jupiter.

On the impact of acoustic radiation on the dynamics of sensitive elements in gyrostabilized platforms

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Space Science and Technology, 1995, **1**, *N 2–6, P. 72—75 (in Russian)*

The paper deals with the mechanism of elastic interaction of acoustic radiation from carrier engines with multi-phase mechanical structure of sensitive elements in the gyrostabilized platform. This phenomenon was analysed qualitatively, and the peculiarities of device dynamics under the conditions of sound influence from working sustainer engines were defined.

Complex imitation of outer space factors

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A complex imitator has been designed and built for a ground-based express imitation of six space factors. The device has no analogs in the Community of Independent States and in the ESA countries. The six factors are the radiation from an artificial Sun ($\lambda\lambda$ 200—2500 nm), vacuum UV radiation ($\lambda\lambda$ 5—200 nm), protons and electrons with energies of 50—200 keV in the Earth's radiation belts, vacuum (10^{-7} torr), thermocyclogenesis in the range 4.2—400 K. The space factors will be studied for their degrading effect on the physical and mechanical properties of various materials as well as on the normal operation of mechanisms and scale models of spacecraft. These experiments will make possible substantiated recommendations as to the use of the materials which are promising in the construction of space systems with lifetimes of 5—10 years.
