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HELICOPTER-BASED LIDAR SYSTEM FOR REMOTE MEASUREMENT OF LASER-INDUCED SPARK AND FLUORESCENCE SPECTRA OF SOIL AND WATER SURFACES

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INTRODUCTION

In this communication we present the results of flight experiments obtained with an lidar system, which have been installed aboard Kamov-32 (KA-32) helicopter and now in operation at General Physics Institute, Moscow, Russia.

The lidar is a part of an ecological complex, which involves supplementary a microwave radiometer (for measurement of soil humidity), a g-spectrometer, a photo-acoustical gas analizer and portable nano-Joule eye-safe lidar for contemporal measurements of aerosol density changes and air pollutions consentrations.

EXPERIMENTAL

The lidar has been disigned to sutisfy of a few quite different tasks:

-oil spills mapping and classification of hydrocarbon pollutions

-detection of natural dissolved organic substance and chlorophyll

-vegetation monitoring of canopies

-elemental analysis of natural waters and soils with the help of emission spectra of laser breakdown on the surface.

Main technical specification of lidar are:

Laser:
Nd^{3+}:YAG, energy 700mJ (1064nm), 300mJ (532nm), 150mJ (355nm), 100mJ (266nm), repetition rate up to 20Hz, pulse duration 8ns.

Optical system:
adjustable transmitting telescope (5cm diameter), Newtonian receiving telescope (20cm diameter, F=50cm), plane aluminium mirror.

Polichromator:
autocollimation optical scheme,
300g/mm diffraction grating, entrance slit 50-200m,
dispersion 40nm/mm (first order), 20nm/mm (second order), transmission in working orders (1-10) 40% at 500nm and 20% at 250nm.

Photo-receiver:
CCD with image intensifier, reception area d=20mm, dinamic range 100 , spectral range 250-750nm.

RESULTS

A series of 10 flight missions were conducted around Kamov's Test Flight Centre (20km to East from Moscow) and in Moscow-river basin between April 20 and June 15, 1993, at the altitude from 40 to 80 meters. The laser-induced leaves and water organic substance fluorescece spectra have been obtained and identified. Strong variations of fluorescence spectral forms of various types of canopies and water surfaces have been detected. Hydrocarbon and chlorophyll fluorescence cross-sections were plotted along the flight lines.

In the special series of experiments we measured the emission spectra of laser-induced spark on the land surface[2]. The helicopter altitude was varied from 8 to 20m. We recorded and interpreted the spark-spectra of a few minerals, concrete, some metal's allois. The atomic lines of Cu, Al, C, H, Si, Fe are clearly distiguished on a background of wide-band thermal emission of the laser induced plasma. The rough estimation of concentration definition for this method is about 0.01-0.001%.

REFERENCES

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