RAMAN LIDAR DESIGNED FOR GAS ANALYSIS AND ATMOSPHERIC TEMPERATURE MEASUREMENT

A Raman lidar is designed for remote analysis of gaseous industrial emissions, for example, just above the mouth of the stacks of enterprises, exhausts of engines at the exit from tail pipes, emissions of gases from damages in gas pipes, and so on. It can be used:

– to determine gaseous composition of industrial emissions,
– to measure the CO, NO, NO_2, and SO_2 concentrations in these emissions,
– to evaluate the outflow rate in gas jets and their temperature, and
– to estimate the mass concentration of aerosols in these emissions.

Moreover, the Raman lidar is capable of remote sensing of humidity, transparency, and temperature of the lower atmospheric layers as well as to reconstruct the vertical profiles of these parameters.

The Raman lidar harnesses the spectra of the Raman lidar light scattering by molecules of atmospheric and polluting gases excited by laser radiation and simultaneous spectral analysis of backscattered laser radiation.

The lidar is assembled in a trailer, in which a signal recording system and microcomputer are placed together with a transmitting–receiving system and a work station for an operator is equipped.

SPECIFICATIONS

Sounding range for measuring:	
a) a gas concentrations, m	500
b) temperature, humidity, and atmospheric transparency, m	1500
Measurable gas concentrations, ppt	10^{-4}
Temperature measurement error, deg	less than 1.5
Spatial resolution, m	10
Relative error in determining the atmospheric transparency, %	3

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MAKREL'–2M MULTIPURPOSE LIDAR INTENDED TO INVESTIGATE SEA WATER AREAS

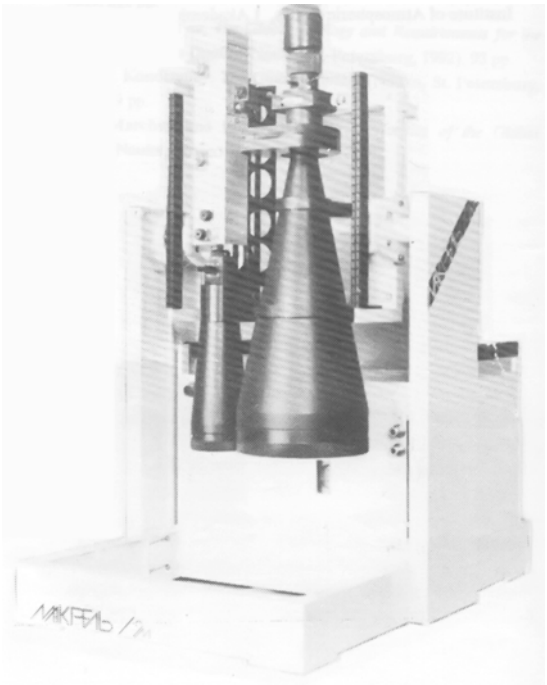
A Makrel'–2M lidar is designed for airborne investigation of water depths to measure the degree of water pollution as well as to detect schools of fish for harvesting. This lidar can be simultaneously used to monitor the air pollution and to study some characteristics of water surface.

The Makrel'–2M lidar is capable of solving the following problems:
– to detect fish shoals for harvesting to access their bioproductivity,
– to determine the water transparency and to identify submerged layers with enhanced turbidity,
– to perform bathymetric measurements of shelf waters and to measure the heights of sea surface waves,
– to detect the petroleum products and chlorophyll in sea water,
– to measure a distance to clouds as well as their density and phase state, and
– to detect emissions of aerosol pollutants into the atmosphere and to estimate mass aerosol concentration of these emissions.

The lidar for its operation harnesses the transmission of pulsed laser radiation with preset parameters and reception of return signal. The parameters of the medium are reconstructed from the variations in lidar return signal parameters.

The Makrel'–2M lidar can operate 24 hours a day under precipitation and sea fog conditions. It can be placed onboard a sea vessel or at the ground, if necessary. In the latter case the lidar is used for atmospheric research.

The Makrel'–2M lidar is built of a transmitter–receiver of optical signals, data recording and processing system, and servicing system. It is of small size and has low energy consumption. Data processing is fully automated. Results of measurements are stored on a floppy disk.



SPECIFICATIONS

Depth for water sensing, m	up to 30
Depth of penetration into a cloud and smoke, m	up to 300
Range of atmospheric sensing, km	up to 2
Flight altitude for water sensing, m	50–800
Flight speed for water sensing, km/h	up to 600
Overall dimensions, m	$1.0 \times 1.2 \times 0.7$
Mass, kg	250
Energy consumption, kW	up to 2

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VZOR ALL–SKY OPTICAL ANALYZER OF ATMOSPHERIC STATE

A VZOR all–sky optical analyzer is designed for automated recording of atmospheric phenomena and processes accompanied by absorption, scattering, and emission of optical radiation in the visible, UV, and IR spectral ranges. The VZOR is capable of 24–hour automated all–sky recording of such atmospheric phenomena as different cloud types and turbidity, trails of bolids and flights of airplanes, occurring of lightnings and anomalous glows, as well as to record evolution and dynamics of the above–enumerated processes.

The VZOR analyzer has two optical channels. The first channel is intended for all–sky observations, and the second channel –– for inspection of the preset sector of the sky in more detail and tracking moving objects. Images in both channels, converted into video signals, are transmitted to video monitors used for visual observation of all sky and its individual sectors or specific objects recognized in the sky. The processes displayed on the screen of the video monitors can be simultaneously recorded on a videotape for subsequent image operation and analysis.

A computer system built in the analyzer is capable of solving the following problems:

– to filter out noise signal,
– to delete some useless details from an image,
– to correct for geometric image distortion,
– to map the linear coordinates of image space into the angular coordinates of object space,
– to compress the recorded information for compact archiving, and
– to automatize all–sky retrieval of predictable phenomena.

The VZOR analyzer is capable of automatic classifying the observed phenomena and revealing the new phenomena.

SPECIFICATIONS

Time of all–sky measurement, s	–1
Field of view:	
a) total, sr	2π
b) local, sr	$(0.005–0.12\pi)$
Angular resolution:	
a) for all–sky coverage, min of arc	17
b) for sector coverage, min of arc	0.5–2.5
Working spectral range, μm	0.4–0.7
Light sensitivity, lx	1–50.000

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IKOS–2 DEVICE FOR MEASURING THE LIGHT EXTINCTION COEFFICIENT

An IKOS–2 device is designed for measuring the meteorological visibility range and spectral light extinction coefficients on the horizontal paths located above the sea surface. Measurements can be performed from a shore or onboard a ship.

The IKOS–2 can be successfully employed for the solution to the following problems:

– investigation of the pattern of optical radiation propagation in various spectral regions,

– monitoring and investigation of the optical–meteorological state of the atmosphere, for example, the meteorological visibility range and atmospheric turbidity,

– optical–meteorological testing of ranging, sounding, and communicating systems, and

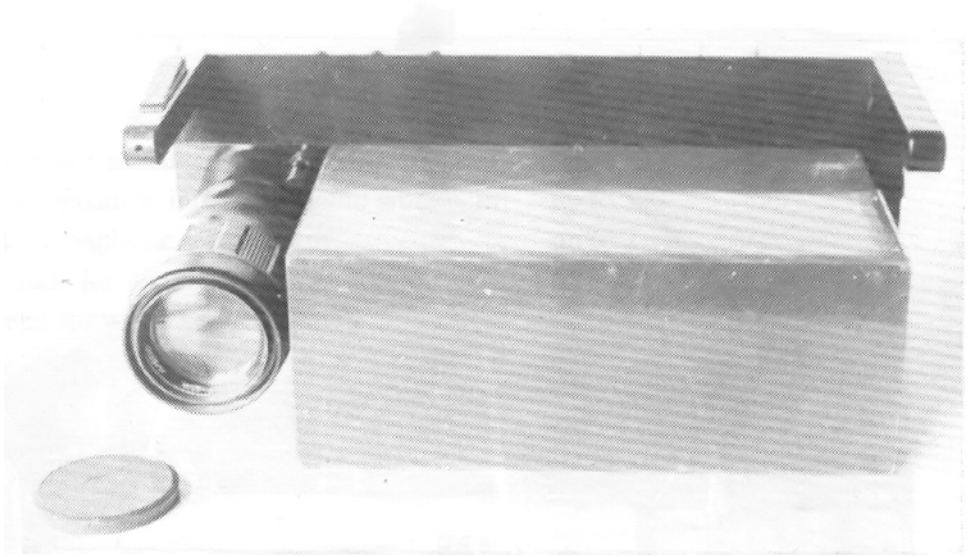
– optimization of opto–electronic devices against energy criterion for different levels of atmospheric turbidity.

The IKOS–2 device is capable of measuring along well–determined directions. It needs no calibrations and can operate under tossing. It is compact and needs no preparation for measurements.

The device harnesses the passive method of atmospheric sounding based on determination of the air turbidity from the degree of blurring of the observed horizon. It automatically performs photometric measurements of angular distribution of brightness of the sea horizon and subsequent signal processing by a special–purpose algorithm.

The IKOS–2 is designed as one module suitable for hand operation. The results of measurements are displayed on a digital indicator of the device. It is operated from a storage battery.

The device is simple in service and can operate 24 hours a day.



SPECIFICATIONS

Measuring range of light extinction coefficients, km^{-1}	0.08–8
Measuring range of meteorological visibility, km	0.5–50
Working spectral range, μm	0.3–1.06
Minimum illuminance needed for operation, lx	1–10
Power supply, W	5
Mass, kg	3.0
Overall dimensions, cm	360 × 210 × 160

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