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PROSPECTS OF USING AN OPTO-ELECTRONIC DRONE LANDING SYSTEM IN REMOTE MONITORING OF GAS PIPELINES IN WESTERN SIBERIA

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Introduction

Of all the air drones flight modes landing is the most difficult one due to the high degree of accidents in this mode. The landing time takes no more than 1-2% of the flight time, but this mode accounts for more than 50% of all accidents.
The implementation of air drones automatic landing is even more difficult task. In this case, instead of the pilot, the on-board control system should solve the tasks of action planning, assessment of the current state and management of the function elements. At the same time, the control system must provide stability, a short time for working out large deviations, adaptability to perturbations and accuracy of reaching a given landing point.
The use of an optoelectronic landing system for a drone can make the necessary actions to monitor the state of gas pipelines in hard-to-reach areas with subsequent sampling and shooting of clearer photos of problem areas without risks of damage to high-tech machinery.

General system concept

Lidar system for detecting gas leaks on main gaslines
An automated laser gas analyzer developed by A.P. Zhevlakov, L.A. Konopelko, A.S. Grishkanich et al. [1] was used as a system for monitoring gas leaks on gas pipelines of the West Siberian gas bearing territory.
The concept of an optoelectronic landing system
The television camera, acting as an optoelectronic radiation receiver, produces a photograph of the surface under investigation obtaining an average level of brightness at the site. Knowing this level, the system adjusts the optical radiation power of the transmitter to the level required for recognition[2]. The radiation source is a semiconductor laser modulated by direct current modulation with a frequency that makes it easier to extract the optical test signal from the subsequent frames from receiver[3].

Calibration

The unit of the experimental sample receiver consists of a Mintron 54G30 television camera, a USB video capture device and a camera-to-computer connection interface using the RS232 standard. The entire calibration cycle was implemented in the MATLAB environment: camera control, frame capture, image processing, mathematical calculation of necessary parameters of the receiver unit. A calibration bench was developed for carrying out calibration measurements, taking into account known parameters of the receiver unit. After a number of measurements, the key parameters for the receiver block studied were calculated. The average arithmetic value of the angular field along the X axis and along the Z axis is 48,8° and 34,4°, respectively. The root-mean-square deviation of the covering power along the X axis was 0,8°, and along the Z-axis - 0,7°. Taking into account the error, the average values of the covering power are equal: along the X axis (48,8±2,4)°, along the Z axis (34,4±2,2)°. The arithmetic mean of the scale factor ratio along the X axis to the scale factor along the Z axis.

Conclusion

In this paper the necessary characteristics of the optoelectronic landing system were estimated. The system receiver unit has also been calibrated. The dependence of scale factors on the X and Z axes on the distance to the plane of the receiver was obtained. Also, the root-mean-square values and deviations of the camera's covering power and ratios of scale factors were estimated.

References

[1] A. P. Zhevlakov, L. P. Konopelko, V. G. Bespalov, V. V. Elizarov, A. S. Grishkanich, D. N. Redka, S. A. et al., 2017 *Proc. SPIE 10431, Remote Sensing Technologies and Applications in Urban Environments II*

[2] H. Lamela, J.R. Lopez, E. Garcia, M.A. Ferreras., 1998, *IECON '98. Proceedings of the 24th Annual Conference of the IEEE*

[3] H. Lamela, M.A. Ferreras, A.J. Varo, 1999, *IECON '99 Proceedings*