Enhancement of Optical Methods and Systems for Object Sensing in Space

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In the field of spatial object sensing, an important task is the investigation of the parameters of both reflected and probing laser radiation. This task is crucial for the development and improvement of technologies used to detect and analyze optical devices. Laser optoelectronic systems are employed to scan the surrounding environment with a laser beam to identify reflective surfaces. This study presents a novel model for investigating the parameters and dynamics of laser radiation, treated as a nonlinear dynamic system. The model facilitates the measurement of physical quantities using nonlinear metrological methods, such as fractal dimension analysis and other topological tools. It is based on the assumption that measured quantities can be represented by interval values and allows for the transition from stationary to random dynamics. The model includes an experimental scheme that outlines various stages and procedures for evaluating measurement results. A key feature of this model is its systemic approach, which enables effective investigation of both stationary and chaotic modes of laser radiation dynamics. This approach allows for the measurement of parameter intervals in different modes, evaluation of their stability, and prediction of time series based on the obtained data. The classification of system dynamics is performed using fractal dimension methods, providing a detailed analysis of laser radiation behavior. The model can be applied both to ensure the stability of laser light parameters and to manage random radiation. The study focuses on a pulsed laser, with the main parameters of radiation including pulse energy, pulse duration, pulse repetition frequency, stability of values, and spectral characteristics. The experimental setup, shown in Figure 1 [1-2], includes an injection system, laser, beam splitters, pulse energy meter, spectral analyzer, pulse duration measurement block, pulse repetition frequency measurement block, and a control, synchronization, and data recording system.

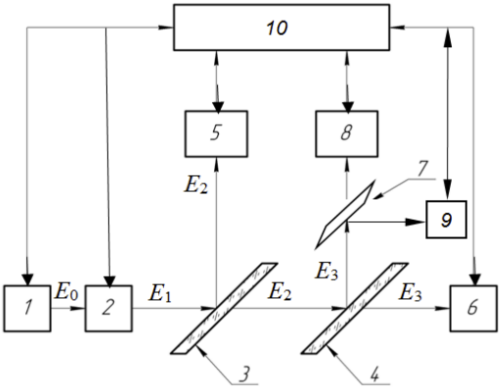

Fig.1. 1 is the injection system; 2 is a laser; 3, 4, 7 are dividing plates; 5 is a pulse energy meter; 6 is a spectrum analyzer; 8 is a pulse duration measuring unit; 9 is a pulse repetition frequency measuring unit; 10 is a system for control, synchronization and recording of the measurement results

This setup provides a comprehensive approach to studying laser radiation parameters and allows for detailed analysis of its characteristics under various experimental conditions.

References

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