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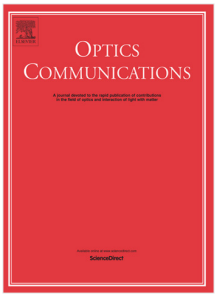

Ranging precision for underwater laser proximity pulsed laser target detection

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Ranging precision for underwater laser proximity pulsed laser target detection

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Abstract

This paper presents a novel echo signal calculation model for the underwater laser detection of short-range targets. An underwater laser ranging process simulation model is established combined with the echo time identification method. The distance distribution of the underwater target laser range was simulated through time delay and peak detection methods. Simulation results show that the distance dispersion forms an approximately Gaussian distribution. The precision of the system as-assessed by time delay method is higher than the peak detection method. The system ranging accuracy decreases as target distance increases. Seawater simulation results are consistent with experimental underwater short-range goals determined in a target range experiment at sea. The small angle scattering approximation error increases when the target distance is far away – at a certain target distance, the simulation results do slightly deviate from the experimental results. The results presented here may provide a workable reference for the parameter design and ranging error correction of underwater near-range target laser detection systems.

Keywords: underwater target detection; laser ranging; ranging precision; time identification
PACS: 42.68.Xy, 07.60.-j, 42.79.Qx, 42.40.My

1 Introduction

Blue and green laser systems provide underwater target detection with higher range, more precise positioning, and better imaging than traditional electromagnetic and acoustic detection. These systems are often utilized for underwater laser short range target detection technology research. Underwater vehicles equipped with laser detectors can complement sonar detection technology, obtain high-precision underwater images, and enhance the detection capability of underwater targets – especially underwater high-speed moving targets – and assist in completing various underwater exploration tasks [1, 2, 3].

Range accuracy is one of the most important system indexes for the underwater target laser detection system. There has been a great deal of research on the measuring accuracy of laser detection systems in air [4, 5, 6]. Few researchers have conducted systematic analyses of the range accuracy of the underwater pulsed laser detection system. When blue and green laser pulses are transmitted underwater, the beam energy attenuates due to the strong absorption and scattering of the seawater. The strong scattering effect causes the beam to diffuse in space, and the multipath effect of the photon leads to optical pulse broadening and transmission delay which altogether degrade the accuracy of underwater pulse laser ranging.

At present, researches on the underwater laser detection system mainly focus on the transmission characteristics of light in seawater and the elimination of backscattering noise [7, 8, 9, 10, 11,

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