# Optimizing Bathymetric Data for the Blue Economy: Robust Sea-Spike Filtering in Single-beam Echo sounder

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**SUMMARY**

Single-beam echo sounders are commonly employed for seabed mapping due to their affordability and ease of use. These devices play a critical role in bathymetric data collection, yet they are susceptible to sea-spike outliers—high amplitude echoes caused by environmental factors that can significantly compromise the accuracy of the data. Manual processing of these outliers is both time-consuming and subjective, presenting challenges in ensuring data reliability. This study introduces a robust sea-spike filtering system (SSFS) aimed at enhancing the quality of bathymetric data. The proposed system utilizes a semi-automated algorithm that incorporates mean absolute deviation (MAD), median filtering (MF), and wavelet transform (WT) to efficiently detect and eliminate spurious data. The SSFS was evaluated using real-world bathymetric datasets, where sea spikes were deliberately introduced for detection. The results demonstrated that the system successfully identified 100% of sea-spike outliers, ensuring high data accuracy and reliability. Statistical analysis revealed minimal deviation between the original and spiked datasets, with a mean spike magnitude of 0.42 meters. Additionally, the system achieved a root mean square error (RMSE) of 0.484 meters, which complies with the International Hydrographic Organizations' (IHO) S-44 Edition 6.1.0, October 2022 standards for vertical uncertainty in hydrographic surveys. These findings underscore the effectiveness of the SSFS in improving bathymetric data quality, supporting sustainable maritime industries, ecosystem conservation, and climate change adaptation, thereby contributing to the safeguarding of the blue economy through accurate and reliable data.