Journal of Acoustical Engineering Society of Iran, Vol. 10, No. 1, 2022

(Research Article)
Solving explicit and implicit methods to estimate the mean size and concentration of suspended sediments using multi-frequency Acoustic Doppler Current Profiler in Wolfram Mathematica

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Received: 2021/08/29, Accepted: 2022/07/09
DOR 20.1001.1.23455748.1401.10.1.10.9

Abstract

One of the new and practical methods of monitoring water resources is Hydroacoustic technology. Using the Acoustic Doppler Current Profiler system (ADCPs) by attenuating acoustic waves against suspended sediment particles in water, the amount of energy loss, the mean suspended sediment concentration, and particle size will be estimated using the formula with multi frequencies without the necessity of sampling. Two computational methods are implicit and explicit inverse methods based on the sonar equation. In this study, Due to the novelty of this issue and the lack of user-friendly software, all the formulas (implicit and explicit inverse methods) are coded in the Wolfram Mathematica. Finally, the various solving steps are discussed with the plots of coefficient and constant attenuations of acoustic waves for different mean sizes of sediment particles. Two peaks in the total attenuation plots for fine and mean coarse particles at two frequencies (600 and 1200 kHz) are obtained (1.08 and 1.44) and (2.14 and 2.86) dB m^2/kg, which are obtained at (0.97 and 963.73) and (0.67 and 482.24) μm, respectively. ADCP at 600 and 1200 kHz frequencies can monitor mean suspended sediment particles from a radius of 0.001 to 1000 μm.

Keywords: Suspended sediment concentration, Suspended sediment sizes, ADCP, Multi-frequencies, Wolfram Mathematica.

pp. 89-104 (In Persian)

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