

# Stepwise inversion method to profile near-borehole formation velocities

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The radial heterogeneity of near-wellbore formation, usually manifested as the variations of formation wave velocities in radial position, is encountered in petroleum exploration and production. Mapping radial

variations of formation velocities is significant in identifying invaded zones and determining rock properties, which are valuable for engineering measures.

Inversion methodologies are the main methods to determine radial wave [velocity](#) profiles. For monopole acoustic well logging, the calculation on arrival time of the waves is required in profiling the P-wave velocity, which is unstable and inaccurate in processing field data with noise.

Recently, researchers from the Institute of Acoustics of the Chinese Academy of Sciences (IACAS) proposed a stepwise [inversion](#) method based on monopole acoustic well logging data to radially profile the near-borehole formation velocities.

The inversion method did not require calculation on the arrival time of waves, thus mitigating the inaccuracy in processing field data with noises. In addition to profiling formation P-wave velocity, the proposed methodology also could be applied in mapping formation S-wave velocity.

Instead of inverting the formation velocity variation and its corresponding radial position simultaneously as traditional methods do, the researchers divided the inversion procedure into two steps: extracting the velocity array by semblance processing of contiguous receiver pairs of acoustic array data, and then getting the thickness of the layer (radial position) based on ray theory.

The inversion results from Step 1 could be used to guide the operation and decide whether Step 2 was necessary.

The modeling-based inversion results and the application to [field data](#) indicated the efficiency and accuracy of the stepwise inversion method. With its fast speed and stability in calculation, this work could provide

real-time data processing results in the oilfield.

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**More information:** Ying Liu et al. Radial profiling of near-borehole formation velocities by a stepwise inversion of acoustic well logging data, *Journal of Petroleum Science and Engineering* (2020). [DOI: 10.1016/j.petrol.2020.107648](https://doi.org/10.1016/j.petrol.2020.107648)

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