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Geoscience Advisor: AI-Driven Automation for Full Waveform Sonic Workflows

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Abstract

Full Waveform Sonic (FWS) data offers valuable insight into subsurface structure and reservoir properties, yet processing this data remains a time-consuming and highly specialized task. Traditional workflows are fragmented, requiring geophysicists to manually apply corrections, interpret signals, and stitch together multiple tools across various platforms.

We present a Geoscience Advisor, a domain-aware AI assistant that transforms this process by integrating natural language understanding, structured retrieval, and automated task execution. The advisor guides users through each step — from quality control and despiking to signal enhancement and zone interpretation using embedded tool knowledge and geoscience-specific reasoning to respond dynamically to user goals. Applied to FWS datasets, the assistant empowers users to build expert-level workflows more efficiently achieving processing speeds up to 3x faster than traditional methods. It supports scalable deployment, as demonstrated by benchmarking tests showing it can handle up to 1,000 queries per hour, with 40 concurrent users maintaining responsive interaction. The system also generates automated QC reports for well data using just a few lines of natural language query, significantly reducing manual effort.

The advisor operates securely in offline environments using optimized semantic models tailored for subsurface data, with no reliance on external services. It is tool-agnostic and has been tested across a range of environments with FWS data, where variations in rock velocity are automatically interpreted to maintain accuracy. By closing the gap between user intent and technical action, the system enhances accessibility for less experienced users while supporting expert refinement. More than a chatbot, the Geoscience Advisor acts as a digital partner — bridging human judgment and machine precision to improve reservoir characterization. This marks a shift toward AI-powered co-pilots in geoscience, where intelligent systems not only interpret data but act decisively, paving the way for scalable, automated solutions in reservoir analysis.