SONIC IMAGING RECENT AND FUTURE DEVELOPMENTS

Abstract:

Sonic imaging workflows map formation features (bedding, fractures, faults, other wellbores) using reflections recorded by acoustic logging tools. While the traditional workflow produces 2D migration images, more recent deliverables (3D model of reflectors and logs of true dip and azimuth, etc.) have been derived directly from the waveform measurements without requiring a migration (Bennett et al, 2019). While deep LWD EM measurements have a long history of providing formation structural information related to bedding and faults (Thiel et al, 2021 and many other publications), operators still desire to map near wellbore structures using acoustics, particularly fractures, to understand, for example, the fluid flow potential for their reservoir.

In the past few years, several simultaneous developments to improve the quality and repeatability of sonic imaging answers have evolved including (1) improved filtering workflows to reduce the interference of the direct borehole modes (Hirabayashi, 2021); (2) improvements in the traditional 2D migration workflows (Hirabayashi, 2016); and (3) work to elicit fully 3D information from the acoustic measurements and provide this 3D mapping of the near wellbore structures without using a migration. This last item has been made possible using an automated time pick combined with an automated ray tracing inversion and 3D slowness time coherence (3D STC) workflow for both monopole measurements (Bennett et al, 2019) and for dipole waveforms (Donald et al, 2020).

More recently, a sonic imaging service was demonstrated on a slim through-the-bit sonic tool to provide a 3D formation mapping closer to drill time (Akinyose et al., 2021). This development, together with a new unified and cloud-enabled processing provides for improved turnaround times and makes sonic imaging more capable of delivering answers in time for completion decisions.

Despite these further developments in sonic imaging capabilities, we observe that today sonic imaging typically provides only the 3D positions of the layer boundaries, fractures, faults etc., and does not include formation properties such as formation layer slowness. This remains an area requiring further development. Positive results in this direction would more closely bind the sonic imaging results to downstream geomechanics and petrophysics workflows and would make sonic imaging a more direct analogue of the LWD EM processing.

Bio:

Nicholas Bennett is currently a Scientific Advisor at Schlumberger-Doll Research Center in Cambridge, MA. where he has been working since completing his Ph.D. in Mathematics from Yale University in 1997. Nick's more recent activities have involved sonic imaging, conveyance of real time LWD NMR measurements, and real time LWD imaging using directional electromagnetic measurements. During 2018-19, Nick served as one of the SPWA distinguished speakers as lead author of "Borehole acoustic imaging using 3D STC and ray tracing to determine far-field reflector dip and azimuth" that won one of the 2018 SPWLA best paper awards.