DrillCam: An Integrated Real-Time System to Image Ahead and Around the Bit

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ABSTRACT

As the number of new exploration and development wells continues to increase over time, guiding navigation while drilling in real time is becoming one of the most sought-after technologies to enable the accurate prediction of high-pressure zones, cavities, and fractures, coring points, target depths, and geosteering in high-quality reservoir zones to optimize drilling decisions and cost reduction. To mitigate these challenges, the DrillCam technology aims to exploit an integrated real-time system to image and predict ahead of the bit and around the well based on seismic-while-drilling analysis. There have been several challenges hindering the success of this technology over the last two decades, including low source-signal intensity, low channel count, and insufficient computational resources in the field to integrate and process different data types in real time. The recent advances in seismic sensor sensitivity, high-channel count surveys, signal enhancement, and imaging algorithms, as well as portable high-performance computational resources that can be deployed in the field, opened a whole new set of possibilities for real-time drill bit guidance and navigation. One key enabler of this technology is the use of wireless receivers. Compared to conventional cable geophone and cableless node systems, wireless receivers can provide: real-time recording and transmission with no need for equipment and data retrieval; flexible receiver spacing and areal coverage for adaptive survey geometry and optimal subsurface illumination as the drill bit depth increases; a lightweight system for easy mobilization; and ultralow power consumption for extended battery life. In this presentation, we show successful 3D tests using the drill bit as a downhole source and dense surface receivers with detailed analysis highlighting the effects of the acquisition geometry design, signal-to-noise ratio, and velocity model on the final image quality.