

Geosteering Benchmark Models for Standardization of Directional Electromagnetic Logging-While-Drilling

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Geosteering is an essential oilfield technique for exploration and production of both conventional and unconventional resources nowadays. As shown in Fig. 1, in the process of drilling a borehole, geosteering is the act of adjusting the well trajectory on the fly to reach the geological targets or to keep the wellbore within desired formation. Directional electromagnetic logging is the most widely used geosteering measurement due to its azimuthal sensitivity, and its relatively large depth of penetration compared with other sensing techniques such as nuclear logging. Directional electromagnetic logging-while-drilling (LWD) tools provide, in addition to conventional formation resistivity measurements, rich information such as distance from tool to bed interface, formation dip angle relative to tool axis, and formation anisotropy (S. Li, J. Chen, and T. L. Binford, SPWLA 55th Annual Logging Symposium, 2014).

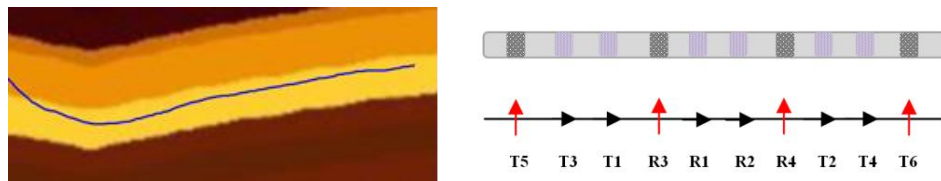


Figure 1: (left) A schematic of geosteering: the bright yellow layer in the center represents reservoir, and the blue line denotes the well trajectory; (right) A schematic of directional electromagnetic LWD tool: the black and red arrows denote antennas with components along and perpendicular to the tool axis, respectively.

Over the last 10 years, several oilfield services companies have designed and developed a number of directional electromagnetic LWD tools, and have demonstrated the effectiveness of these tools in various environments all over the world. Recently, a new generation of directional electromagnetic LWD tool, with a much larger depth of investigation (around 100 ft) compared with the previous generation (10-20 ft), have been developed for more challenging and proactive geosteering jobs. Despite all the progress and success, it is commonly believed that directional electromagnetic LWD services, especially the ultra-deep new generation, are underutilized in the geosteering practice. Important reasons are lack of common definitions of key parameters and lack of common benchmark models for performance evaluation of directional electromagnetic LWD tools on the market, which eventually lead to lack of communications between services companies who make the tools and operators who use the service.

In 2016, a special work group in the well logging society was formed, including all the major operators and service companies, as well as several research institutes, to standardize and promote directional electromagnetic LWD in geosteering services. A key task of this work group is to propose benchmark models for several typical geosteering scenarios and to specify the evaluation of tool performance based on electromagnetic modeling of the benchmark models. In this talk we will present the recent efforts of this work group, with a focus on computational challenges in the geosteering benchmark models.