ABSTRACT

A new fiber and gyro logging tool is designed to overcome magnetic field interference for open hole and cased wells in offshore oilfield applications. Fluxgate magnetometers are often used as a sensor in the conventional azimuth logging tool. However, magnetic field disturbance can cause inaccuracy. An inclinometer using fiber optic gyrooscope is designed for well track measurement. Fiber optic gyroscope is used as azimuth sensor with data acquisition system based on DSP and FPGA in this inclinometer. Several tests are conducted and compared with the drill curve. Test results show that the tool is within the accuracy limit for engineering applications. The tool is unaffected by the magnetic field compared to traditional orientation logging and logging FOG orientation as the azimuth. The tool also can measure the attitude angle continuously so that it can guide the oil production operations by following continuous trajectory. The tool has potential to much broader application such as sonic flaw detector in combination, cement evaluation, well retest, cased damage detection and other engineering works. The new tool, especially in combination with the cement bond tool and acoustic flaw detector, can be widely used in the cement evaluation, the well repetition logging, oil casing damage detection.

TOOL DESCRIPTION

The FGAT is an measurement system, which can get the well track by continuous, accurate measurements in three-dimensional space. The measurements of the tool are DEV, RB, DAZ and AZ. With proper interpretation, this information can be used to produce a directional survey of the well, orient and correct other log data for toolstring rotation while logging.

The FGAT uses a high-quality three-axis quartz flexible accelerometer and high-precision FOG as sensors. Since the output of the gyro is free from the magnetic environment outside, it is applicable for both open hole and cased well. After the filter processing of results from all sensors, the data acquisition system of the downhole tool calculates the attitude angle using the inertial navigation algorithm then uploads. And it also has a detection process of the output and eliminates the drift error for accuracy to ensure the reliability of the measurement.

THEORY OF FOG NORTH-SEEKING

Based on the Sagnac interference principle (Bergk, Lefèvre, Shaw, 1981; Lefèvre, 1993; Liang, 2006), FOG can obtain rotation rate of the fiber coil by measuring phase shift between two counterpropagating light waves in it. Phase shift $\Delta \varphi$ and the optical path difference $\Delta L$.