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Improving Surface Oscillation Tools Performance Using Time-Domain Dynamics and Torque and Drag Models

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Abstract

Overcoming friction in sliding mode represents a challenging task when drilling an unconventional well with a long lateral section. Among the possible ways to reduce these frictional forces is to use a surface oscillation tool (SOT). By alternating the rotation at surface between the forward and reverse directions, apart of the friction forces is transferred from the axial to tangential direction. Hence, a better transmission of the weight to the drill bit and increased rate of penetration can be achieved. To take full advantage of this tool, an accurate and fast modeling of the influence of its oscillation characteristics is necessary.

The SOT is operated at surface by changing its rotation speed and number of wraps in forward and reverse directions. If these characteristics are underestimated, the torsional oscillations are quickly stopped by the friction moments, and the rate of penetration is not increased enough. However, if they are over estimated, the torsional oscillations can reach the bent motor, and destabilize the tool face orientation (TFO). In this paper, a full time-domain dynamics model and a simplified model coupled with a stiff-string torque and drag model are used to identity the influence length of the SOT, and hence provide an opportunity to optimize its operating parameters.

Full and simplified models are compared to each other to ensure their validity. Namely, the effect of the drillstring-wellbore contact distribution is showed to have a substantial impact on the SOT performance. Consequently, it was proved that optimal SOT characteristics Off-Bottom are generally not enough to overcome the friction when drilling. In addition, the torque and drag model is applied to a real case study of an unconventional well with surface and downhole data. It helps provide the driller with a guideline of recommendations on the SOT parameters. These results open some very interesting perspectives in terms of TFO accuracy and slide optimization.

The use of modelling in the calibration of the SOT characteristics and the development of the simplified model are both novelties introduced here. This work should lead to significant improvement to extend the length of laterals with steerable mud motor with minimum tortuosity.