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# Micro Dogleg Detection with Continuous Inclination Measurements and Advanced BHA Modeling

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## Abstract

Micro doglegs are a natural effect of any vertical or directional well that can explain a wide variety of down hole problems, from additional torque and drag to an inability to run completions. These doglegs are inherent to the rock drilling process and can generate borehole spiraling in vertical sections or sliderotary pattern when using steerable mud motor in horizontal sections. Standard surveying every 95ft or so cannot detect these micro doglegs and only gives a partial look at the actual well path. This paper presents the results of a case study showing how accurate downhole measurements combined with advanced drill string modeling can detect borehole tortuosity and better quantify the down hole drilling efficiency.

A trajectory prediction model able to calculate the inclination and azimuth each foot or so has been developed to estimate micro doglegs using standard surveys, bottom hole assembly (BHA) data and steering parameters. In the demonstrated case, a slick motor assembly was used to drill a horizontal well in a single run. The predicted trajectory was then compared to actual continuous inclination data gathered by the measurement while drilling tool during drilling and showed a good match between the predicted trajectory and the actual drilled trajectory. Transitions between sliding and rotating modes are highlighted by micro doglegs and downhole forces, such as bending moment close to the bit, are well reproduced by the model.

This new methodology combining downhole data measurements with drill string modeling analysis highlights the potential for drilling optimization and wellbore placement. Having a better definition of the well path is very critical for torque and drag analysis and wellbore placement. This paper presents for the first time a comparison between continuous survey measurements and computer modeling to highlight the importance of micro-doglegs in evaluating drilling performance.