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Validation of Directional Survey Data Against Positional Uncertainty Models

Marc Willerth; Stefan Maus

Abstract

Positional uncertainty is a critical component of managing collision risk while drilling. Ensuring that survey data meet the requirements of their uncertainty models has historically required complicated analysis. Most consumers of survey data are not experts and knowing when escalation is required in a high-risk situation can be unclear. This problem will increase as more data is evaluated by automated decision-making systems. Two novel methods are proposed to analyze sets of survey data against uncertainty models with the intent to answer the questions: "Is it safe to continue drilling" and "Does this wellbore need to be resurveyed?".

The proposed methods evaluate a survey set using the error sources, error magnitudes, and error propagations contained in positional uncertainty models. A quality control error covariance matrix is constructed, and the set is evaluated against it. Two statistical outputs are generated: a statistical distance that explains how well an additional survey fits with the existing survey data, and an overall survey assessment that describes the likelihood of an error-model compliant system producing the observed dataset.

The methods are used to evaluate downhole magnetic survey data that was flagged after evaluation by subject matter experts, but traditional quality control measures had failed to identify as problematic. Errors that do not fit the expectations of the error model are flagged in a way that is apparent to a non-expert user and can be integrated into an automated alert system. How to include these procedures in drilling workflows is discussed, including when escalation to a subject matter expert is required.

A system is proposed where, with minor modification to existing error models, this analysis can be automated for wellbore surveys of all kinds. Additional discussion is included on how these methods will fit into the upcoming API recommended practice on wellbore surveying.