UNLOCKING DATA ANALYTICS FOR THE AUTOMATIC EVALUATION OF CEMENT BOND SCENARIOS

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Abstract:

Cement bond evaluation is a critical step in the early-life stages of newly drilled wells since it rules the way for obtaining useful information about wellbore integrity. Conventionally, this is carried out by means of a detailed interpretation of cased-hole sonic and ultrasonic log data. However, this standard approach can be highly time consuming and challenging in long completion sections and when complex scenarios have to be handled in operative time.

In this respect, oil companies have stored huge datasets for their wells, with quality-checked cased-hole acoustic logs and associated interpretations in terms of wellbore integrity. This paper deals with a novel, probabilistic data analytics approach aimed at obtaining a fast and robust cement bond facies classification. The latter is deemed able to automatically provide an exhaustive quantitative cement placement evaluation, hence avoiding time-consuming processes and possible subjectivity issues.

The implemented methodology takes advantage of the Multi-Resolution Graph-based Clustering (MRGC) algorithm that gathers its knowledge by recognizing patterns in sonic and ultrasonic logs/maps from dozens of wells, including more than 500K meters of logged intervals. This allows the system to learn through experience how the log measurements are related to the common cement bond scenarios (e.g. good, partial, poor cementation, dry or wet micro annulus, free pipe). The MRGC is then integrated in a Bayesian framework to obtain the probability of the cement bond facies, the most probable scenarios, and the associated uncertainty by means of entropy computation. In detail, an automated screening can be performed in newly drilled wells to detect possible problems of hydraulic sealing.

The potentialities of the discussed method are demonstrated by real case applications consisting of cement log data collected from several blind-test wells. First, the probabilistic approach is used to predict the cement bond scenarios together with the uncertainties of their classification. Then, an unbiased evaluation of the results is performed. The successful outcomes coming from the final step of the workflow show how, with a statistically representative and good quality dataset, data analytics can efficiently mimic high-skill expert work in harsh circumstances and within a time-efficient template. In fact, this data-driven methodology takes few seconds to provide an exhaustive interpretation against, at least, one day with the conventional one.

Bio:

Dario Reolon joined Eni recently since 2019 as a Production Petrophysicist for advanced well characterization activities. His activities include cased hole formation evaluation, wellbore integrity analysis and production logging interpretation. Dario holds two II level Master Degree in Petroleum Engineering (Polytechnic University of Turin, Italy) and in Petroleum Geology (University of Basilicata, Italy). He took a MSc in Energy Resources and Sedimentary Basins and a BSc in Geology from the University of Milan, Italy.