Chapter 12
Development of DNN Model for Predicting Surge Pressure Gradient During Tripping Operations

Shwetank Krishna
Universiti Teknologi PETRONAS, Malaysia

Syahrir Ridha
Universiti Teknologi PETRONAS, Malaysia

Pandian Vasant
Universiti Teknologi PETRONAS, Malaysia

ABSTRACT

Application of machine learning tools in drilling hydrocarbon well is still exploratory in its stage. This chapter presents a brief review of various applied research in drilling operations using machine learning (ML) tools and develop a deep neural network (DNN) model for predicting the downhole pressure surges while tripping. Tripping in or out drill-string/casing with a certain speed from the wellbore will result in downhole pressure surges. These surges could result in well integrity or well control problems, which can be avoided if pressure imbalances are predicted before this operation is engaged. Existing analytical models focus on forecasting the pressure imbalance but requires cumbersome numerical analysis. This could be solved by integrating DNN tool with the best existing analytical model predicted dataset. Consequently, the aim of this chapter is to provide an overview of various applications of machine learning tools in drilling and presenting a step-by-step process of developing a DNN model for the prediction of downhole pressure surges during tripping operation.

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INTRODUCTION

The purpose associated with this book chapter is to explain the development of an intelligent model using deep neural network (DNN) for controlling well integrity problem during tripping operations. This model uses the historical or real-time data for predicting the surge/swab pressure associated with tripping operations. By prescribe remedial solution for lost circulation zone by integrating different data sets equip by various service companies. This model will further optimize the drilling operations, reduces non-productive time (NPT) and lowers drilling risks.

In comparison with other method, ML finds quick results from data due to its flexibility and automatic perception. Machine learning is a data analytics method that educates computers to do what comes normally to people and animals: learn from experience (Pankaj et al., 2018). Machine learning calculations utilize computational strategies to “learn” data specifically from information without depending on a foreordained condition as a model. The algorithms adaptively improve their execution as the number of tests available for learning increases (Pankaj et al., 2018). In fact, ML can deal with the lack of proper physical models or in the presence of uncertainty that usually effect the outcomes in other approaches. The thought of ML is to prepare a model on known input and yield data so that it can foresee future yields (supervised learning) or finding covered up designs or inherent structures in input data (unsupervised learning) (Raschka & Mirjalili, 2017). Then when different input arrives, the ML predict the correct output by applying what it has been taught. For this, ML will require a large set of selective data (historic and real-time data) to develop this model. The drilling business has endured a ton because of various drilling anomalies. An industry average estimate of the additional cost to the well caused by lost circulation specifically, is around 40 percent, with most of this cost due to rig down-time (Reddy, Zhang, & Ellis, 2016). This is excluding the apparatus costs because of the harm to the drill pipe and/or blowout. This could be optimized by developing predictive models.

Motivation

Currently, oil & gas business facing difficulty to exploit artificial intelligent innovations to upgrade operational decision making for drilling anomalies. According to the literature survey, there are a few restrictions in the way, well development information is as of now procured and gave by the service contractor companies or organizations in a manner, such as, constrained access to the information, numerous information sources that are not really open by means of every one of provider’s frameworks and reliance on exclusive software tools and services from the providers for post-preparing/examining information to educate operational choices to forestall or relieve or mitigate or prevent any lost circulation occasions (Andia, Sant, & Whiteley, 2018). According to Unrau and Torrione, 2017, formation fluid influxes and drilling fluid losses is bound to happen during drilling operation. Detection of these phenomena during real-time operation is complicated due to varying and transient nature of fluid rheological parameters during drilling. This make the deployed detection sensor to malfunction and provide false alarm on a regular basis. Since, rate of false alarm increases with increasing complication, rig personnel start to treat these alarm as unreliable.
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