

## Chapter 32

# Strictness Petroleum Prediction System Based on Fuzzy Model

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### ABSTRACT

*Petroleum exploration and production is an industry that provides researchers with multi-variant challenging “real world” properties. Recently, some petroleum soft computing techniques have gained a greater interest in prediction within the oil industry. This paper is interested in the analysis, classifying, mining and predictions, based on fuzzy as an intelligent system and an intelligent system called the Strictness Petroleum Prediction System (SPPS), predicted results and statues of crude oil wells and they are compared with other measurement petroleum values. The evaluation study applies test cases, regression models and time series forecasting of vague petroleum datasets to achieve more accurate results. A regression model was made to show the effect of re-testing the prediction processes of petroleum factors. Prediction in time series using a non-parametric functional technique is considered, based on data which was collected from different sources (Daqing oilfield in China and distinct oilfields in Yemen).*

### 1. INTRODUCTION

The rise of petroleum importance was mostly due to the invention of the internal combustion engines. The petroleum industry while traditionally conservative has a surprisingly long history and high usage of testing and deploying artificial intelligence (AI) or soft computing systems (Al-marhoun et al. 2012). Today, about 90% of vehicular fuel needs are met by oil (Abude, 2012). The prediction is flexible due to the property of fuzzy logic methods because the temporal pattern cluster is selected as a set, each point in a temporal pattern cluster belongs to a cluster with a specific membership degree, furthermore, the event prediction is predicted accurately (Azar, 2012). To focus on the prediction, there is a difference between prediction and forecast, where forecast processes support a range of outcomes; prediction processes achieve a detected prediction result. In addition, the forecast process used in computational

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procedures to estimate the parameters of models also being used to allocate limited resources. Create an intelligent system for crude oil prediction is the basic goal of this work.

The prediction technique depends on fuzzy set and experts' knowledge for validation, as a hierarchy system, multiple functions are used, dataset acquisition, data mining (classification, clustering), prediction and evaluation (test cases, regression and time series forecasting). All these processes pertain on a general proposed system called the Strictness Petroleum Prediction System (SPPS). Data mining is a technique of discovering useful patterns in data that are hidden and unknown in normal circumstance. In addition, data mining consists of machine learning, statistics and database design. It uses methods such as clustering, classification, association rule mining and probabilistic graphical dependency models to identify hidden and useful information from large databases (Mahdavi et al. 2012; Azar, 2010a, b).

Prediction processes propagates the process of prediction which considers measurement values and exploiting the specific inputs through software testing. The test case processes explain the fundamental differences between system results and previously tested values. Consequently, test cases on a petroleum prediction domain are able to manipulate the faults of predicted system results (Aydin et al. 2009). Three test case processes used to re-testing the system's results are: execution, infection and propagation. The precision within test case statues are approved by using the regression test to propagate failures of the prediction system (Salem et al. 2004). Using regression test processes on petroleum domains allow engineers to enhance the oil industry and improve the prediction statues (Demyanov et al. 2011). In the regression analysis, the p-value (predicted value) shows how the environmental factors (that is the independent variables) affect the model and what is the importance of environmental factors. Using regression test functions reduce the cost of huge systems regression models try to predict dependent variables as a function of other correlated observable independent variables (Mayo et al. 2013). As a remedy, time series analysis is not the only way of obtaining forecasts (Frank et al. 2001). Conceptually, time series data mining methods are based on fuzzy logic (Victor et al. 2013). The goal of this paper is to build complete petroleum intelligent system that contains different functions such as: classification, data mining, prediction, test cases; regression and time series forecasting models.

The rest of the paper is organized as follows: System overview and architecture are provided in Section 1. Then, Section 2 shows related work; Section 3, explains the SPPS architecture; Section 4 shows system senario expermients and finally, Section 5, shows the system results and suggestions for future work.

## **2. RELATED WORK**

More than one intelligent system is used on crude oil prediction domains. There are many studies regarding petroleum prediction using soft computing technology. Modeling the time series is a statistical problem, one of the proposed algorithms was implemented on 91 rows of data (monthly oil consumption) from January 2003 to July 2010 for Canada and the rate of accuracy is 95%. Another related work considers a data driven approach in modeling uncertainty in spatial predictions, based on Bayesian inference presented as an envelope in p10/p90 of credible intervals for reservoir production predictions (Kordnoori et al. 2011).

One of the research purposes is to use Support Vector Machines (SVMs) as a novel machine learning technique for predicting outputs in uncertain situations by using the  $\epsilon$ -support Vector regression ( $\epsilon$ -SVR) method (Idlii, 2009; Nagi, 2009). The objectives of these researches are to investigate the capability of SVRs in modeling PVT properties of crude oil systems (Rafiee et al. 2010 ; Jaubert et al.

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