DM4OG

Workshop on Data Mining for Oil & Gas

http://dm4og.inesctec.pt

The Westin Galeria Houston, Texas, USA

The process of exploring and exploiting Oil and Gas (O&G) generates a lot of data that can bring more efficiency to the industry. Although there are several examples of research papers on data mining and soft computing applications in the O&G related sciences, the opportunities for using data mining techniques in the "digital oil-field" remain largely unexplored or uncharted. The significant challenges posed by this complex and economically vital field justify a meeting that brings together researchers and practitioners from data science, data mining, forecasting, geophysics, petrochemistry, marine and petroleum geology, applied mathematics, and other disciplines, to explore the utilization of data mining techniques to develop intelligent solutions for O&G related modeling and optimization problems.

Invited Speaker

German Larrazabal, Senior R&D Geophysicist,
Geoscience Technology Upstream, Repsol US

"Geobody Detection from 3D Migrated Seismic Data"
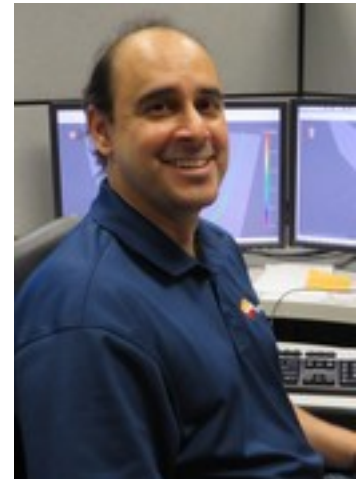
Presentations

Matthias Kormaksson, Jorge Guevara, Bianca Zadrozny, Ligang Lu, John Tolle, Mingqi Wu, Jan Limbeck, Detlef Hohl and Tyler Croft

"A data-driven workflow for predicting horizontal well production using vertical well logs"

In recent work, data-driven sweet spotting technique for shale plays previously explored with vertical wells has been proposed. Here, we extend this technique to multiple formations and formalize a general data-driven workflow to facilitate feature extraction from vertical well logs and predictive modeling of horizontal well production. We also develop an experimental framework that facilitates model selection and validation in a realistic drilling scenario. We present some experimental results using this methodology in a field with 90 vertical wells and 98 horizontal wells, showing that it can achieve better results in terms of predictive ability than kriging of known production values.

Mohammadmehdi Ezzatabadipour, Parth Singh, Melvin Robinson, Pablo Guillen-Rondon and Carlos Torres

"Deep Learning as a Tool to Predict Flow Patterns in Two-Phase Flow"

In order to better model complex real-world data such as multiphase flow, one approach is to develop pattern recognition techniques and robust features that capture the relevant information. In this paper, we use deep learning methods, and in particular employ the multilayer perceptron, to build an algorithm that can predict flow pattern in two-phase flow from fluid properties and pipe conditions. The preliminary results show excellent performance when compared with classical methods of flow pattern prediction.

Athar Khodabakhsh, Ismail Ari and Mustafa Bakir

"Cloud-based Fault Detection and Classification for Oil & Gas Industry"

Oil & Gas industry relies on automated, mission-critical equipment and systems built upon the cooperation and interaction among them. To assure continuous operation and avoid any supervision, architects embed Distributed Control Systems (DCS), {a.k.a.} Supervisory Control and Data Acquisition (SCADA) systems, on top of their equipment to generate data, monitor state and make critical online & offline decisions.

In this paper, we propose a new Lambda architecture for oil & gas industry for unified data and analytical processing on data received from DCS, discuss cloud integration issues and share our experiences with the implementation of fault-detection and classification modules inside the proposed architecture.

Hamed Nikhalat Jahromi and Alipio M. Jorge

"An Overview of Data Mining Applications in Oil and Gas Exploration: Structural Geology, and Reservoir Property-Issues"

Low oil prices have motivated energy executives to look into cost reduction in their supply chains more seriously. To this end, a new technology that is experimentally considered in hydrocarbon exploration is data mining. There are two major categories of geoscientific problems in which data mining is applied, these, which both address geophysical issues, are: structural geology, and reservoir property-issues. This research overviews these categories by considering a variety of interesting works in each of them. The result is an understanding of the specific geophysical problems studied in the literature, along with the relative data mining methods. This way, this work tries to lay the ground for a mutual understanding on oil and gas exploration between the data miners and geoscientists.

Rui L. Lopes and Alípio M. Jorge

"Mind the Gap: a well log data analysis"

The main task in oil and gas exploration is to gain an understanding of the distribution and nature of rocks and fluids in the subsurface. Well logs are records of petro-physical data acquired along a borehole, providing direct information about what is in the subsurface. The data collected by logging wells can have significant economic consequences, due to the costs inherent to drilling wells, and the potential return of oil deposits.

In this paper, we describe preliminary work aimed at building a general framework for well log prediction. First, we perform a descriptive and exploratory analysis of the gaps in the neutron porosity logs of 1026 wells in the North Sea. Then, we generate artificial gaps in the neutron logs that reflect the statistics collected before. Finally, we compare Artificial Neural Networks, Random Forests, and Generalised Linear Regression in the prediction of missing gaps on a well-by-well basis.

Manoela Kohler, Leonardo Forero and Marco Aurelio Pacheco

"Neural Network Proxy Applied to Reservoir and Surface Integrated Optimization"

The development of an oil reservoir consists in finding a configuration of wells that contributes to maximizing the revenue to be obtained from the recovered reservoir oil. The pursuit for this alternative is often based on optimization processes using the net present value (NPV) of the project as the evaluation function of the wells configurations found during this pursuit. Among other variables, the NPV calculation is directly dependent on the oil, gas and water production data during the productive life of the reservoir, as well as their development costs. Determining the number, location, type (producer or injector) and the trajectory of wells in a reservoir is a complex optimization problem which depends on a lot of

variables, including the reservoir properties (such as porosity and permeability) and economic criteria. The optimization processes applied to this type of problem has a high computational cost due to the continuous use of simulators that reproduce the conditions of the reservoir and the surface system. The use of simulators may be replaced by proxies. At the present work, proxies were constructed using artificial neural networks. The proxies presented here are meant to replace the integrated reservoir, well and surface (production lines and riser) simulation to reduce the computational cost of a decision support system. The samples for the proxies' construction are produced using reservoir and surface simulators. To reduce the number of samples needed for the proxy construction, and, to reduce the dimension of the problem, Latin Hypercube and Principal Component Analysis are used. The proxies were tested in an oil reservoir with real features. The results indicate that these proxies can perform well in replacement of simulators in the optimization process due to low errors found and a substantial decrease in computational cost.

Organizing Committee:

Alípio Jorge, University of Porto, Portugal
German Larrazabal, Repsol USA, Houston, Texas, USA
Pablo Guillen, University of Houston, Texas, USA
Rui L. Lopes, INESC TEC, Porto, Portugal

Program Committee:

Alípio Jorge, University of Porto, Portugal

Carlos Ferreira, Instituto Superior de Engenharia do Porto, Portugal

Eirini Ntoutsi, Gottfried Wilhelm Leibniz Universität Hannover, Germany

German Larrazabal, Repsol USA, Houston Texas, USA

Hamed Nikhalat-Jahromi, INESCTEC, Porto, Portugal

Lei Huang, Curtin University, Sarawak, Malaysia

Omair Shafiq, Carleton University, Canada

Pablo Guillen, University of Houston, Texas, USA

Paulo Azevedo, University of Minho, Braga, Portugal

Robertas Damaševičius, Kaunas University of Technology, Lithuania

Rui L. Lopes, INESCTEC, Porto, Portugal

Shahab D. Mohaghegh, West Virginia University, USA

Yasin Hajizadeh, Schlumberger, Houston, Texas, USA