Geophysical Insights - University Challenge Topics

Call for Abstracts

GEOPHYSICAL INSIGHTS
FROM INSIGHT TO FORESIGHT

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Challenge Topics - 2019 are offered to universities who are part of the Paradise University Program. Those universities are encouraged to consider pursuing one or more of the topics below in their research work with Paradise® and related interpretation technologies. Students interested in publishable papers on one or more of these topics are welcome to submit an abstract and paper to Geophysical Insights, including a side document explaining their interest in the topic, for private review in anticipation of public publication. Staff of Geophysical Insights will select up to three of the best papers with abstract from those submitted which have addressed one of the **Challenge Topics - 2019**. For each of the best papers, we will award a grant of $1,000 for up to three students per paper. Student(s) who undertake research on one of these topics may count on additional support from Geophysical Insights, including:

- Research collaboration, if appropriate, via web meeting, email, or phone with one or more senior geoscientists
- Recognition at the Geophysical Insights booth at a future SEG International Convention
- Invitation to webinars hosted by Geophysical Insights on geoscience topics
- Potential job interviews after graduation

Challenge Research Topics

Investigate a geophysical and/or machine learning factor for the identification of thin beds below classic seismic tuning

Research on this topic will investigate applications of new levels of seismic resolution afforded by multi-attribute Self-Organizing Maps (SOM), the unsupervised machine learning process in the Paradise software. There are mathematical, physical and geophysical bases for this new technology. The mathematical basis of detecting events below classical seismic tuning through simultaneous multi-attribute analysis - using machine learning classification - has been reported by Smith (2017) . An updated version of the abstract is placed online at the Geophysical Insights website as a white paper resource. Geophysical factors include reference wavelet shape, signal/noise ratio, geological reflectivity both vertical and lateral. Machine learning factor include the neuron topology map, e.g. number of winning neurons, connectivity, etc., and attribute selection list. Examples of thin-bed resolution have been documented in a Frio onshore Texas reservoir, and in the Texas Eagle Ford Shale by Roden, et al., (2017). Therefore, researchers are challenged to develop a better understanding of the physical basis for resolution of geologic events below seismic tuning vs. results from conventional wavelet-based methods. Case studies of the detection of thin beds are also welcomed. This approach has wide potential for both exploration and resource management of unconventional reservoirs.. For unconventional plays, thin bed delineation will have a significant influence on directional drilling programs.

Determine the effectiveness of 'machine learning' calculated geobodies in estimating reserves/resources and reservoir properties

The Paradise software has the capability of isolating and quantifying geobodies that result from a SOM machine learning process. Initial studies conducted with the technology

suggest that the estimated reservoir volume is approximately what is being realized through the life of the field. This Challenge is to apply the geobody tool in Paradise along with other geobody modeling techniques and field data to determine the effectiveness of geobodies in estimating reserves. If this proves to be correct, the estimating of reserves from geobodies could be done early in the lifecycle of the field, saving engineering time while reducing risk.

Corroborate SOM classification results to well logs or lithofacies

A challenge to cluster-based classification techniques is corroborating well log curves to geologic or seismic-derived lithofacies. Up to this point, such corroboration has been an iterative process of running different neural configurations and visually comparing each classification result to "ground truth". Some geoscientists (results yet to be published) have used bivariate statistical analysis from petrophysical well logs in combination with the SOM classification results to develop a representation of the static reservoir properties, including reservoir distribution and storage capacity. The challenge is to develop a methodology incorporating SOM seismic results with lithofacies determination from well logs.

Explore the significance of SOM low-probability anomalies (DHIs, anomalous features, etc.)

In addition to a standard classification volume resulting from a SOM analysis, Paradise also produces a "Probability" volume that is composed of a probability value at each voxel for a given neural class (neuron). This technique is a gauge of the consistency of a feature to the surrounding region. Direct Hydrocarbon Indicators (DHIs) tend to be identified in the Paradise software as "low probability" or "anomalous" events because their properties are often inconsistent with the region. These SOM low probability features have been documented by Roden et al. (2015) and Roden and Chen (2017). However, the Probability volume changes with the size of the region analyzed, and extent of the DHIs and other anomalous features. This challenge will determine the effectiveness of using the probability measure from a SOM result as a valid gauge of DHIs and set out the relationships among the optimum neural configuration, the size of the region, and extent of the DHIs.

Map detailed facies distribution from SOM results

SOM results have proven to provide detailed information in the delineation and distribution of facies in essentially any geologic setting (Roden et al., 2015; Roden and Santogrossi, 2017; Santogrossi, 2017). Due to the high-resolution output of appropriate SOM analysis, individual facies units can often be defined in much more detail than conventional interpretation approaches. Research topics should be related to determining facies distribution in different geological environments utilizing the SOM process, available well log curves, and regional knowledge of stratigraphy.

For more information on Paradise or the University Challenge Program, please contact:

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