DIRECT: **DI**gital **RE**servoir **C**haracterization **T**echnology

Industrial Affiliates Proposal

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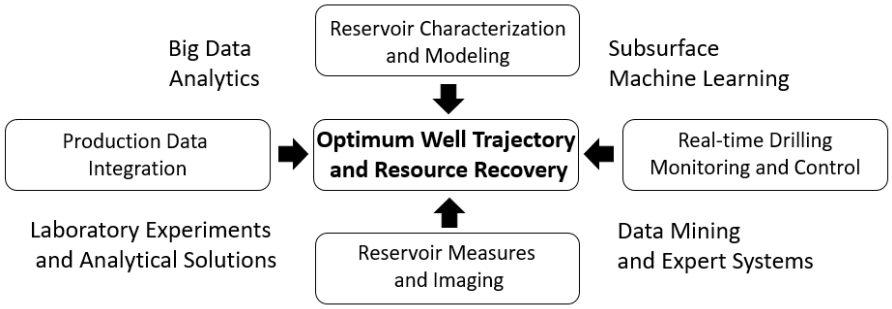
Opportunity

Recent numerical developments and improved computational resources have led to a rapid expansion of big data analytics and machine learning implementations. Oil and gas has a long history with big data from seismic surveys, production monitoring along with various other remote sensing and well-based data, and has developed various physics-based engineering and stochastic statistical workflows. There is an opportunity to combine best-practice and cutting-edge technology in reservoir spatiotemporal characterization and modeling, production data integration, reservoir geophysics and real-time drilling control with big data analytics and machine learning to optimize well trajectory and resource recovery.



Optimum well trajectory and resource recovery through integration of engineering, data analytics, and machine learning.

The hydrocarbon industry requires high-resolution, integrated physics-and geology-based and data-driven, real-time updateable models that are cost-effective, interpretable, efficient, and reliable for production-oriented optimum decision-making, for both conventional and unconventional resources.

This **DIRECT** industrial affiliates program, based in the Hildebrand Department of Petroleum and Geosystems Engineering, at the University of Texas at Austin, will work to develop these integrated modeling and decision support systems to solve the following outstanding problems:

- **Integration**: Maximizing the integration of deterministic engineering, geological description, target-oriented drilling, geophysical measurements, borehole formation evaluation, production history and core data to construct high-resolution reservoir models for improved production forecast accuracy.
- **Characterization:** Improving the spatial resolution of reservoir description and modeling based on enhanced data integration for improved development decision-making.
- **Grey Box Modeling**: Development of big data analytics and machine learning methods that fully account for geospatial and engineering knowledge.
- **Robust Decision Making:** Automated, expert systems to support consistent evaluation of subsurface and production data.
- **System Interpretability:** Advanced system summarization and spatial visualization for model interrogation and learning from models for credible decision support.
- **Optimum Drilling:** Development of modern, production-oriented drilling strategies by designing trajectories for optimum well placement to maximize reserves intersection and recovery factors by primary or secondary production means.
- **In-fill Drilling**: Development of modern, efficient, and cost-effective strategies to evaluate in-fill drilling, primary or secondary production, and intelligent feedback control systems for reactive production under variable geological, fluid and financial constraints.

- **Uncertainty Quantification**: Development of modern methods to ascertain the value of measurements and the uncertainty of descriptions and quantifications.
- **Modern Software Solutions for Reservoir Characterization**: Development of modern computer and software solutions for rapid and efficient 3D collocated multi-physics description, visualization, modeling, well geosteering, and production forecasting.

Short-term Goals (1-2 years)
The consortium will develop new methods and workflows in spatial, big data analytics for petrophysical, geophysical, reservoir engineering and geomechanical integration into subsurface models for optimum well trajectories and reservoir recovery, including:

- Novel big data analytics methods and workflows for data debiasing, imputation of missing data, feature and anomaly detection.
- Novel reservoir-oriented methods for geophysical data processing and interpretation for high-resolution reservoir description and updating.
- Well-documented examples, best practice workflows and case studies, training and mentoring for development of member company operational capability.

Mid-term Goals (3-4 years)
The consortium will develop novel machine learning-based geomodeling and forecasting methods and workflows.

- Novel machine learning methods and workflows for spatiotemporal, multivariate modeling that account for data bias, spatial correlation and trends, multivariate physics-based constraints that are robust in the presence of sparse data and big data.

Long-term Goals (5-6)
The consortium will develop real-time updateable expert systems for optimum field development.

- Novel integrated systems for optimum production-oriented well geo-steering and completion.
- Port algorithms and key findings into a modern computer and software architecture and protocols for user-friendly interactions, diagnostics, learning and decision support.

Consortium Leadership
The faculty leading this IAP are uniquely capable to address these challenges, given our strong knowledge concerning geology, geophysics, geomechanics, drilling and completions, reservoir engineering, formation evaluation, geostatistics, reservoir modeling, data analytics and machine learning.

Membership
Consortium start-up requires three supporting partner companies at $60k/year. At this level of support, the consortium will be able to support 3-4 PhD students to conduct the planned research supervised by leading faculty and while integrating input from the consortium participants. Interested companies are welcome to join now. We will host a formal kick-off session in Houston, late May 2019.

We are happy to discuss,

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