

**A Short Course for the
Oil & Gas
Industry Professionals**

DATA-DRIVEN RESERVOIR SIMULATION & MODELING

**An Alternative to Numerical Reservoir
Simulation & Modeling**

***Using Data as the Main Building Blocks
for Comprehensive Reservoir Simulation
Modeling is the New Paradigm in Reser-
voir Engineering and Management of
Complex Fields***

Course Description:

This course covers the fundamentals of Artificial Intelligence and Data Mining (AI&DM) and provides the theoretical background for its most used components such as artificial neural networks, genetic optimization and fuzzy logic.

The short course will provide insight on application of data-driven modeling in reservoir simulation and modeling. The participants will learn how to develop reservoir simulation models from data. When data from field measurements are used the reservoir simulation model is called Top-Down Model (TDM) and when the data from an existing numerical simulation model are used the model is called Surrogate Reservoir Model (SRM).

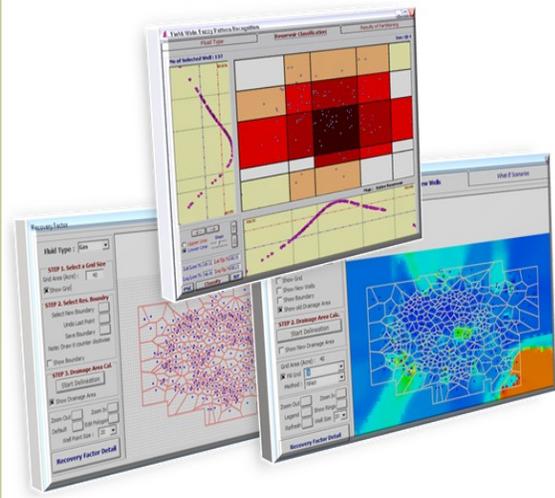


INTELLIGENT SOLUTIONS, INC.



Experience:

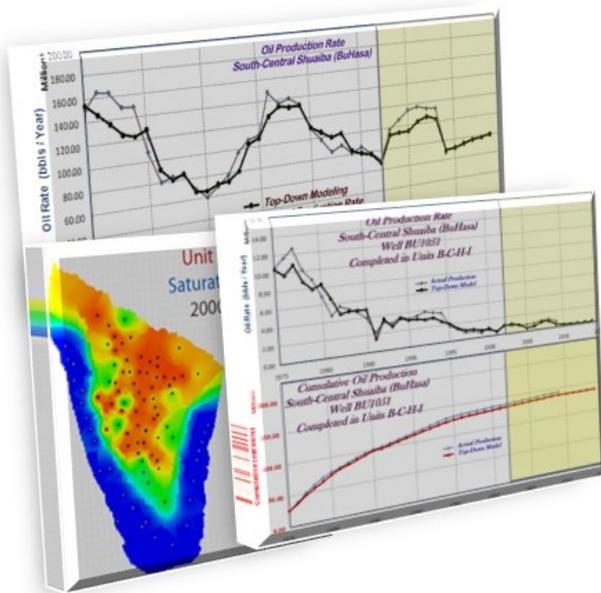
This short course has been taught successfully, numerous times as in-house training to national oil companies and to audiences from many major oil companies.

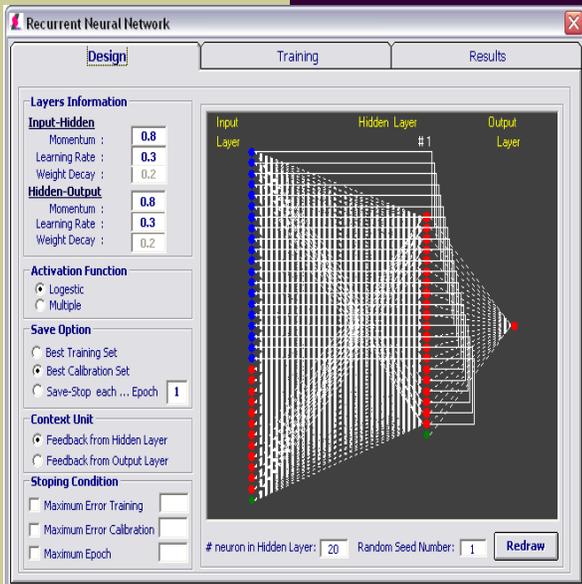


TOP-DOWN MODELING—TDM:

Intelligent Solutions, Inc. introduces a revolutionary and innovative alternative/complement to traditional numerical reservoir simulation and modeling. Top-Down Modeling; may be defined as developing a calibrated (history Matched) model of the hydrocarbon producing reservoir that integrates multiple instance of field measured properties such as production and injection data, logs, cores, well tests, seismic, etc. into a cohesive predictive model of the field. Instead of using first principle physics to model the fluid flow in the porous media, Top-Down Modeling uses the pattern recognition capabilities of Artificial Intelligence and Data Mining (AI&DM) techniques to arrive at a consistent full field reservoir simulation model with superb predictive capabilities.

Top-Down Modeling approaches the reservoir simulation and modeling from an opposite angle. It attempts to build a realization of the reservoir by starting with well production behavior (history). The production history is complemented by any other field measurements (no interpretations) such as well logs, cores, well tests and seismic data. A unique workflow is used to assimilate a comprehensive spatio-temporal dataset from the available data. This dataset forms the foundation of the Top-Down model. This innovative and novel approach to reservoir modeling can be used as an alternative (at a fraction of the cost) to traditional numerical reservoir simulation models in cases where performing simulation is cost (and man-power) prohibitive. In cases where a numerical model exists, Top-Down Modeling should be considered a compliment to the conventional technique, to provide an independent look at the data coming from the reservoir/wells for optimum development strategy and recovery enhancement.





SURROGATE RESERVOIR MODELING—SRM:

Large computational footprint is the main reason behind under-utilization of numerical reservoir simulation models that results in low modeling ROI.

Surrogate Reservoir Model (SRM) is an accurate replica of a traditional numerical reservoir simulation model. It is **NOT** a statistically generated response surface.

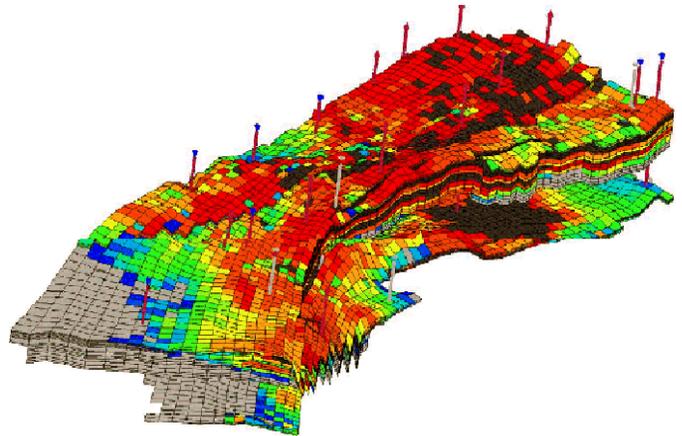
Invented by ISI, SRM uses machine learning and pattern recognition to capture the physics being modeled by the numerical simulation and then mimics its behavior with up to 98% accuracy.

SRM has the capability of reproducing highly accurate well-based and grid-based simulation responses as a function of changes in reservoir characteristics and operational constraints, in fractions of a second. SRM is used for fast track, comprehensive reservoir analysis (solving both direct and inverse problems) using existing reservoir simulation models. SRM is defined as *replica* of the full field reservoir simulation model that runs and provides accurate results in real-time.

Unlike conventional geo-statistical approaches (response surfaces, proxy models ...) that require hundreds of simulation runs SRM is developed only with a few (from 10 to 30 runs based on the size of the model and number of wells) simulation runs.

SRM has proven its value in the field by accurately replicating some of the most sophisticated reservoir simulation models including giant oil fields, coal bed methane reservoirs and CO₂ sequestration models.

SRM is instrumental in comprehensive fast track reservoir analysis and quantification of uncertainties associated with the geological (static) models.





ABOUT THE INSTRUCTOR

Dr. Shahab D. Mohaghegh is professor of Petroleum & Natural Gas Engineering at West Virginia University and founder and president of Intelligent Solutions, Inc., the leading company in providing the oil and gas industry with solutions based on artificial intelligence & data mining (AI & DM).

With more than 20 years of experience, Dr. Mohaghegh has pioneered the application of AI&DM in the exploration and production industry. He has successfully used Artificial Intelligence and Data Mining in applications related to the smart fields, formation evaluation, reservoir characterization, reservoir simulation, and reservoir management as well as drilling, completion and surface facilities. In 2011 Shahab D. Mohaghegh was the recipient of U.S. Secretary of Energy's Achievement Award for his technical contribution to DOE's efforts in addressing the Deepwater Horizon Oil Spill. He has been appointed by the U.S. Secretary of Energy, in two different administrations, to serve on the Unconventional Resources Technical Advisory Committee as a subject matter expert, a position he currently holds. This committee advises the Secretary of Energy directly and specifically on the Unconventional Resources research programs.

He has published more than 150 technical articles and has been granted and completed more than 50 research and development projects. He is the associate editor of various technical journals such as SPE Reservoir Evaluation and Engineering Journal, Journal of Natural Gas Science and Engineering, International Journal of Oil, Gas and Coal Technology, and technical editor and reviewer of several petroleum related journals such as Journal of Petroleum Science and Engineering, Computers & Geosciences, Geophysics, Applied Energy, and Energy & Fuels. His technical articles on the application of Artificial Intelligence & Data Mining (AI&DM) in the oil and gas industry and their recent developments have appeared in the *Distinguished Author Series of SPE's Journal of Petroleum Technology (JPT)* during September, October and November issues of 2000 as well as the April issue of 2005. As a *SPE Distinguished Lecturer* for 2007-2008 he was invited to 16 countries and delivered 26 lectures .

He is the program chair of SPE's newest technical section, "Petroleum Data-Driven Analytics—PD²A". He is the chair of SPE's Global Training standing Committee. He co-chaired the first SPE forum on Artificial Intelligence in 2009 and has also served as discussion leader and technical presenter in various SPE forums and has served as invited speaker and steering committee member in several SPE Applied Technical Workshops.

Shahab D. Mohaghegh holds B.S. and M.S. degrees in Natural Gas Engineering from Texas A&I University and Ph.D. in Petroleum & Natural Gas Engineering from The Pennsylvania State University.

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