TRAINING COURSES

Instructors:

Palash Panja, Ph.D.
Post-Doctoral Research Associate

Raul Velasco, Ph.D.
Post-Doctoral Research Fellow

Course Structure
Lecture, presentation materials, sample models & class participation through short exercises.

Duration
3 to 4 day

Location
EGI's Salt Lake facilities or Member's location

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Introduction to Reservoir Simulation Theory & Application

Available to EGI Corporate Associate Members

Overview

Conventional analytical and semi-analytical methods used to describe, evaluate, and predict the production behavior of simple wells give us great insight into the physics of hydrocarbon production. However, as we move towards heterogeneous and highly complex systems such as horizontal wells in shales, naturally fractured formations, multilayered target zones, multiwell projects, etc., we face increasing challenges in the number of analytical tools available to us. Production decisions become even more critical during industry downturns, creating enormous pressure on engineers and geologists to correctly evaluate existing and new projects. Reservoir simulation technologies have profoundly changed the game for reservoir engineers by adding a whole new evaluation tool capable of handling almost any problem.

Significant differences in important prediction and evaluation results are observed when simulations are not performed efficiently. In this short course, we introduce clients who are new or familiar to reservoir simulation to important aspects such as the theory and the fundamentals necessary to make educated decisions. Indeed, reservoir simulation is only as good as the available data as well as the analysis and insight that the simulation user brings. Upon completion of the course, participants will add value to their companies by performing adequate and rigorous simulation studies as well as being able to troubleshoot common simulation issues.

Introduction

➢ Background and importance of reservoir simulation
➢ Analytical and semi-analytical methods versus numerical methods
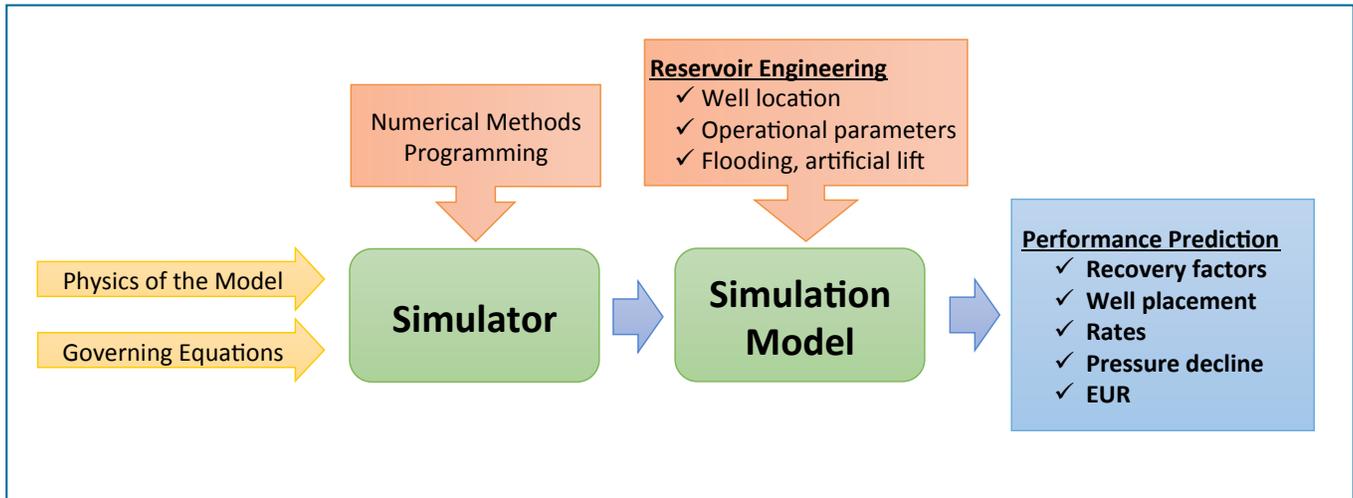➢ Assessment of simulation results

Theory Fundamentals & Simulation Development

- ➢ Reservoir engineering topics (PVT, relative permeability, Darcy's law, etc.)
- ➢ Derivation of governing equations
- ➢ Assumptions and simple exercises
- ➢ Simulation framework
- ➢ Equation development and discretization
- ➢ Solution methods
- ➢ Well models

Numerical Methods Programming

Reservoir Engineering
- ✓ Well location
- ✓ Operational parameters
- ✓ Flooding, artificial lift

Physics of the Model

Governing Equations

Simulator

Simulation Model

Performance Prediction
- ✓ Recovery factors
- ✓ Well placement
- ✓ Rates
- ✓ Pressure decline
- ✓ EUR

Commercial Simulation Application

- ➢ Introduction to commercial simulators: CMG and Eclipse
- ➢ Essential engineering and geologic data before running simulations
- ➢ Input data format
- ➢ Simple examples (Vertical wells, waterflooding, etc.)
- ➢ Analysis of simulation output (fluid rates, pressure distributions, etc.)
- ➢ Troubleshooting: Typical problems, convergence issues, errors, warnings, modification of simulation controls, etc.
- ➢ Complex examples (Hydraulically fractured horizontal wells, multi-well projects, compositional simulation, etc.)

Palash Panja, PhD
RESEARCH SCIENTIST

Palash Panja joined EGI in 2015 as a Post-Doctoral Research Associate. He is an instructor in the Department of Chemical Engineering teaching courses for BS in Chemical Engineering and MS in Petroleum Engineering. He is working closely with EGI Affiliate Scientist Dr. Milind Deo on the Improved Liquid Recovery in Shales project, Palash is examining various reservoir engineering aspects of conventional and unconventional reservoirs as well as working on existing EGI projects and developing new projects in collaboration with EGI staff and Corporate Associates.

After receiving his Master's degree from the Indian Institute of Technology, Bombay, Palash earned his Ph.D. in Chemical Engineering from the University of Utah, specializing in petroleum and reservoir engineering.

Palash has worked 5 years with a variety of companies ranging from downstream companies to upstream production companies to University research. He worked for three years for ONGC, India's largest public E&P Company, serving as a production engineer on an offshore gas and condensate production platform.

As a graduate research assistant at the University of Utah, Palash worked on EGI's Liquids from Shales Phase 1 and 2 projects, enhancing his global oil and gas understanding through direct experience with a variety of unconventional plays throughout the United States, including the Bakken, Barnett, Eagle Ford and Niobrara.

Panja's current interests include production optimization from unconventional reservoirs while minimizing the environmental impacts, improved hydrocarbon recovery, CO_2 capture and injection, geothermal field development, interactions between flow and thermodynamics, surrogate model development, data analysis using machine learning etc. He has published more than 20 articles in journals and conferences.

Research Experience & Focus:

- Generate surrogate models for black oil and condensates in shales for quick production forecast, sensitivity study, and to assess the uncertainties in recoveries.
- Understand the flow and thermodynamic behaviors of hydrocarbons in nano-pores through molecular dynamics simulation.
- Develop model for completion and production from fractured basement reservoirs.
- Study the importance of petrophysical and other parameters on production and recovery from shales.
- Design an efficient system to extract heat from an enhanced geothermal system (EGS)
- Apply machine learning in various aspects of reservoir characterization, field development, completion, production and completion operational strategies.
- Develop and improve modules of University developed in-house reservoir simulator A.R.T.S.

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Research Interests

- Improved liquid recovery from shale
- Enhanced Geothermal System (EGS)
- CO_2 capture & injection
- Machine learning
- Molecular dynamics in nanopores
- Rock on a chip
- Food, Energy & Water nexus

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EGI
Energy & Geoscience Institute
AT THE UNIVERSITY OF UTAH

Since 1972
Energy & Geoscience Institute
... the science to find energy

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Research Interests

- Conventional and unconventional reservoir engineering
- Reservoir simulation development
- Tight oil and gas production analysis
- Molecular Dynamics
- Artificial Intelligence

Affiliate Scientist Raul Velasco originally joined EGI as Postdoctoral Research Fellow in 2016, where he worked closely with EGI Affiliate Scientist, Professor, and Chair of the Department of Chemical Engineering at the University Utah, Dr. Milind Deo. As a research fellow, Raul developed novel semi-analytical and numerical techniques to help understand, model, and predict the behavior of unconventional reservoirs. Raul also taught the theory and development of reservoir simulation as well as the application of commercial simulators, to Petroleum Engineering Masters students at the University of Utah.

As a Petroleum Engineering and Mathematics undergraduate student, Raul worked at the Physics & Astronomy Department designing and building antennas for the IceCube neutrino detection project in Antarctica. This experience was formative in developing a career in science and engineering research. He later obtained his Ph.D. in Chemical Engineering at the University of Utah, where he focused on the reservoir engineering study of unconventional reservoirs. As a research assistant, Raul contributed to EGI's Liquids from Shales, Phase 1 and 2 projects where he developed tools to help evaluate tight formation potential. After working with Schlumberger as a reservoir engineering intern, Raul developed a new discrete fracture representation framework designed to facilitate the modeling of complex hydraulic and natural fracture networks. As an active member of the Society of Petroleum Engineers (SPE), Raul has presented his work at workshops and conferences and served as vice-president of the University of Utah student chapter. He was also recipient of EGI and ConocoPhillips fellowships as well as the John Zink graduate scholarship award.

Research Experience & Focus:

- Developed semi-analytical methods for the multiphase production analysis, evaluation, and prediction of unconventional reservoirs.
- Contributed to research projects that involved reservoir engineering studies of the Eagleford, Niobrara, and Bakken.
- Studied tight oil decline rates and proposed optimal fracture and well spacing based on well production, completion, and economic trends.
- Developed reservoir simulation programs with novel discrete fracture representations for simple and complex fracture network models.
- Implemented machine learning methods to forecast oil and gas production from hydraulically fractured reservoirs.
- Experimentally verified bubble point shift in confined fluids.
- Currently exploring the effects of nano-scale transport in shale porous media by use of molecular dynamics.