



Society of Petroleum Engineers

Workshop Steering Committee

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Texas A&M University

Chris Farmer
Schlumberger/
University of Oxford

Geir Naevdal
IRIS

Dean Oliver
University of
Oklahoma

Greg Walker
BP

Closed-Loop Reservoir Management

>> Application deadline:
14 March 2008

Apply inside or online
at www.spe.org/atws

Workshop Description

Closed-loop reservoir management, also known as real-time reservoir management, consists of life-cycle optimisation based on uncertain reservoir models in combination with the updating of these using production measurements, 4D seismic, and other data. The underlying hypothesis is that there is significant scope to increase recovery through frequent life-cycle optimisation based on frequently updated models. Essential elements of closed-loop reservoir management are model-based optimisation and data assimilation techniques (automatic history matching), and in particular, their integrated application in a reservoir-management workflow. In addition, techniques for model reduction and uncertainty assessment may play a role. As the field application of true closed-loop is in its infancy, the texture of the event will be a workshop with elements of a forum. This SPE Applied Technology Workshop (ATW) will explore the intellectual solutions, technology, and tools that are available and those that are needed to accelerate the routine field application of closed-loop reservoir management.

A unique feature of this ATW will be the opportunity to participate in a benchmark project to test the use of flooding optimisation and history-matching methods. This project will be organised in the form of an interactive competition during the months preceding the ATW, such that the results can be compared and discussed during the workshop.

Workshop Objectives and Deliverables

Through presentations and extensive discussion, we will seek ways to provide answers to the following critical questions:

- What is the optimal frequency for the updating of reservoir models and production strategies?
- How can we best combine long-term reservoir management with short-term production optimisation?
- What are the observable and controllable variables in our reservoir models and which parameters can be identified from data?
- What is the optimal level of detail (both in space and time) for control-relevant reservoir models?
- What are the most important decisions, and how can we focus our measurement strategy and modelling efforts to support those?
- What is the scope to apply closed-loop reservoir management in secondary and tertiary recovery?
- What can we learn from other disciplines such as industrial process control, meteorology and oceanography?

Who Should Attend?

- Oil and gas industry engineers and scientists responsible for the development and employment of technology and software for the field application of assisted history matching, production optimisation, or closed-loop reservoir management
- Academics actively engaged in research related to closed-loop reservoir management

Closed-Loop Reservoir Management

Workshop Timetable

Monday

1500 hours	Hotel Check-In
1700–1800 hours	SPE Registration
1800–1900 hours	Welcome Reception
1900 hours	Welcome Dinner

Tuesday

0830–0915 hours	Keynote Speaker: Adolfo Henriquez, StatoilHydro
0915–1030 hours	Session One
1030–1100 hours	Coffee Break
1100–1230 hours	Session One
1230–1330 hours	Lunch
1330–1500 hours	Session Two
1500–1530 hours	Coffee Break
1530–1700 hours	Session Two

Wednesday

0900–1030 hours	Session Three
1030–1100 hours	Coffee Break
1100–1230 hours	Session Three
1230–1330 hours	Lunch
1330–1500 hours	Session Four
1500–1530 hours	Coffee Break
1530–1700 hours	Session Four

Thursday

0900–1030 hours	Session Five
1030–1100 hours	Coffee Break
1100–1230 hours	Session Five
1230–1330 hours	Lunch
1330 hours	Workshop Closes

Tuesday, 24 June 2008

Session One

Assimilation of Production and Seismic Data into Reservoir Models

Session Managers: Wen Chen, Chevron, and Akhil Datta-Gupta, Texas A&M University

This session will focus on the integration of production and seismic data into reservoir models. The emphasis will be on the role of history matching on improved performance forecasting and production optimisation as opposed to obtaining a single history-matched model. Field examples will be included in most of the presentations. Some of the topics addressed will be

- Data assimilation in other disciplines
- Integration of time-lapse seismic for improved reservoir management
- Sequential (continuously updating models when new measurements are available) vs. nonsequential/traditional (updating the model and matching all available measurement data using an optimisation algorithm) approaches to history matching
- Uncertainty assessment in performance forecasting

Session Two

Life-Cycle Production Optimisation Under Uncertainty, Including Well Positioning

Session Managers: Khalid Aziz, Stanford University, and Greg Walker, BP

The second session will examine the effects of the depletion plan on a field, with the intent of covering both how robust the depletion plan is to the geological uncertainty and how the depletion can generate surveillance information to reduce uncertainty.

We will also aim to explore a range of timescales, crossing from real-time optimisation, which may act as a sequence of interference tests, through to longer strategic decisions involving well placement and potential changes in recovery mechanism as the field matures.

- How should we optimise future production on the portfolio of models?
- How should we simultaneously optimise surveillance acquisition and production to close the loop?
- How is the optimisation altered by the frequency of model updating?
- How should long-term reservoir management be linked to short-term production optimisation?

The session will emphasise field examples with a combination of uncertainty mitigation strategies through different depletion plans and identification of feedback loops for different types of surveillance.

Wednesday, 25 June 2008

Session Three

Decision Making and the Value of Information

Session Managers: Chris Farmer, Schlumberger/University of Oxford, and Dean Oliver, University of Oklahoma

This session will focus on the various sources of uncertainty, their effect on the decision-making process, and the computation of optimal production controls. Although the optimal control strategy is clearly a function of the unknown reservoir properties, uncertainty in future oil and gas prices will also impact particular economic objectives. Speakers will address the value of information on decision making and methods of reducing uncertainty in reservoir forecasts through improved reservoir monitoring. Specific questions will include when, where, and what data should be collected to optimise decision making and production objectives.

Closed-Loop Reservoir Management

Wednesday, 25 June 2008 continued

Session Four

System-Theoretical Aspects

Session Managers: Sigurd Ivar Aanonsen, Centre for Integrated Petroleum Research, and Alberto Cominelli, Eni

In closed-loop reservoir management, the number of model parameters to be estimated and the number of controls may both be large. However, basic control theory indicates that reservoir system models often have many unobservable and/or uncontrollable states, i.e., many more states than can be uniquely determined from the outputs, or can be uniquely influenced by the inputs. Similarly, the model parameters are usually not uniquely identifiable from input-output measurements. Model reduction and reparameterisation can be applied to adjust the model complexity to a level that makes the states controllable and observable and the parameters identifiable. This session focuses on theoretical and practical aspects of modern control theory that can impact applications of closed-loop reservoir management, with examples from other industries where control theory applications are routine and from integrated operations in the oil industry.

Presentations will cover the following areas:

- Methods for model reduction, regularisation, and reparameterisation
- Identification and model-based control of dynamical systems, with applications in industrial processes and reservoir engineering

Thursday, 26 June 2008

Session Five

Presentation of the Benchmark Problem

Session Managers: Rob Arts, TNO, and Geir Naevdal, IRIS

The workshop committee will develop a test case for data assimilation and production optimisation methods on a waterflooded oil reservoir. To this end, they will release a dataset, with the intent that workshop delegates can discuss their history match and production strategies from a common basis, thus providing a reference for future developments in this field. Although the production-optimisation step will be done much less often than in true closed-loop reservoir management, the test problem will require application of the same principles necessary for practical implementation of the method.

The session will effectively start prior to the ATW. In February 2008, a 3D synthetic dataset will be made available to interested parties. The dataset consists of 100 upscaled realisations of a 3D geological model (in Eclipse format); well-log data from wells with fixed positions; the first 10 years of the production history of the field (including measurement errors); inverted time-lapse seismic data in terms of (uncertain) pressures and saturations; and economic parameters for oil, water, and discount rate.

We would like participants to come up with a history match (either a single matched "best" model or a matched ensemble) based on the available data and an optimal production strategy (without infill drilling) for the next period (20 years). If that strategy is ready to test in April–May 2008, participants are invited to send it to TNO for testing on the "real field" to obtain additional production data over a 10-year period. Using these production data, the participants can update their reservoir model and revise their optimal production strategy for the final period of production.

Participants are invited to, but not required to, present their results at the workshop.

To participate and obtain the dataset with instructions, please contact Rob Arts at TNO. (rob.arts@tno.nl)

General Information

Format

The workshop will consist of 2½ days of informal sessions, with a number of in depth presentations and extensive opportunity for discussion in each session. There will also be an evening welcome reception and dinner on Monday, 23 June.

Poster Sessions

The steering committee plans to hold poster sessions during the workshop. Please indicate on your application form if you would like to present a poster.

Attendance

Attendance will be limited to a maximum of 80 delegates with proven experience and/or knowledge of the subject areas being covered. The steering committee will evaluate the applications for a balance of companies, geographic origin, and individual experience. Those selected to attend will receive full joining instructions at the end of March 2008.

Scribe's Report

The steering committee will appoint a scribe to make a full report of the workshop, summarising all presentations and discussion. This report will be circulated to all attendees. The copyright of the scribe's report will belong to SPE.

Attendance Certificate

All attendees will receive a certificate from SPE attesting to their participation.

Continuing Education Units

The workshop qualifies for SPE Continuing Education Units (CEUs), at the rate of 0.1 CEU per hour of attendance at the workshop.

Cost and Residency Information

Attendance at the workshop is residential. The residential rate is GBP 895 and includes the welcome reception and dinner on Monday, 23 June; three lunches; coffee breaks; all workshop sessions; the scribe's report; and 3 nights' bed and breakfast at the NH Brugge Hotel.

Cancellation Policy

Written notice received 30 days before the starting date of the workshop entitles registrants to a 50% refund.

There will be no refund for cancellations received after this time.

Application Form

Attendance is limited and is not guaranteed. Early application is recommended. Please print or type in black ink.

First Name/Forename _____ Middle Name _____

Last/Family Name _____ SPE Member? Yes No Member No. _____

Job Title _____ Company/Organisation _____

Address _____

City _____ State/Province _____

Post Code _____ Country _____

Telephone _____ Facsimile _____

Email (required) _____

Details of relevant experience: _____

Do you want to present a poster? Yes No If "Yes," please provide topic and attach abstract: _____

Please indicate which category below most accurately describes your job title:

- | | |
|--|--|
| <input type="checkbox"/> Reservoir engineer | <input type="checkbox"/> PhD/MSc student |
| <input type="checkbox"/> Production engineer | <input type="checkbox"/> Manager |
| <input type="checkbox"/> Geoscientist | <input type="checkbox"/> Consultant |
| <input type="checkbox"/> Researcher | <input type="checkbox"/> Other |

WORKSHOP FEES

Residential Fee: GBP 895

Cost includes: All workshop sessions; welcome reception and dinner on Monday 23 June; three lunches; coffee breaks; scribe's report; and 3 nights bed and breakfast at the NH Brugge Hotel.

Please note the committee will review all applications and select attendees based on balance of companies, geographic origin and individual experience. Those selected to attend this workshop will receive full joining instructions at the end of March.

Mail, fax, or email completed Application Form to: SPE Applied Technology Workshop
Society of Petroleum Engineers
3rd Floor, Portland House, 4 Great Portland Street, London W1W 8QJ UK
Telephone: +44 (0)207 299 3300 Facsimile: +44 (0)207 299 3309

For questions or additional information, contact Theresa Callanan, Event Organiser, at tcallanan@spe.org, or Sophie Young, Secretary to the Events Administration Manager at syoung@spe.org.

Deadline for application is 14 March 2008.