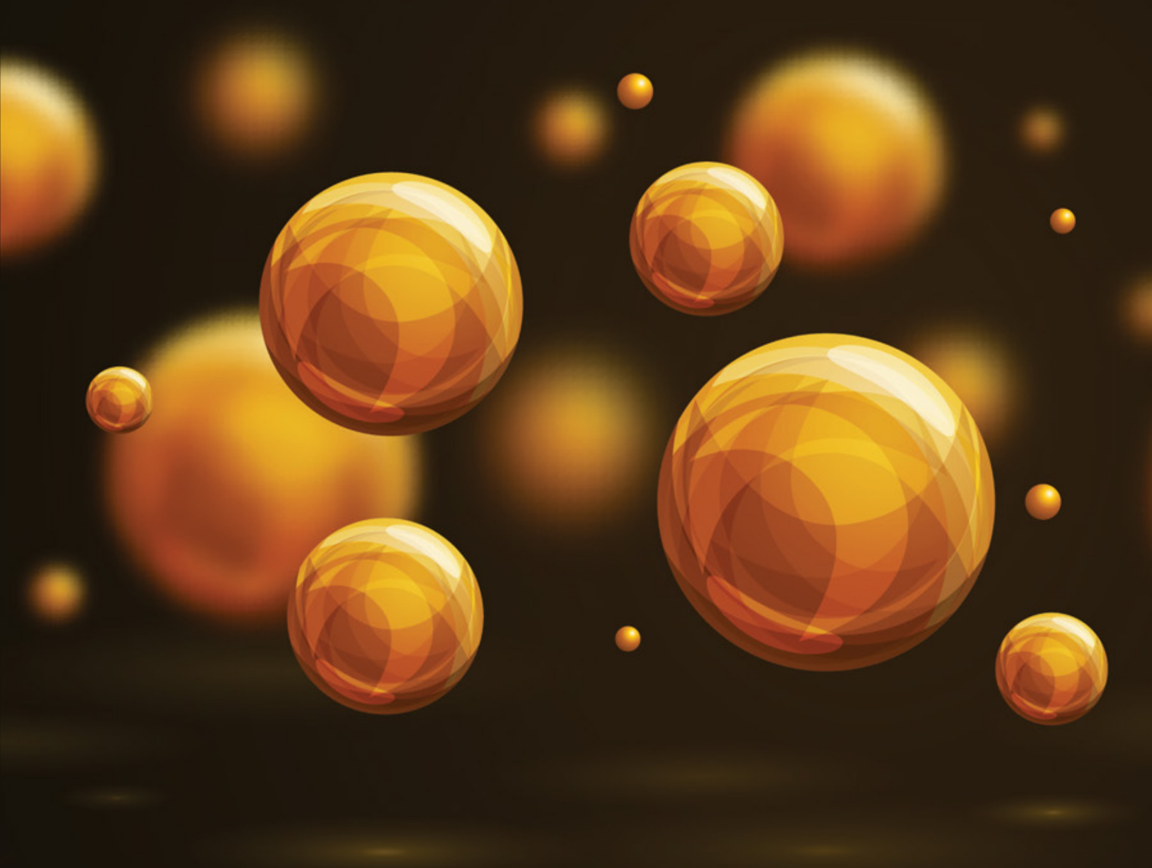

EXPERIMENTAL DESIGN IN PETROLEUM RESERVOIR STUDIES

MOHAMMAD JAMSHIDNEZHAD

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Experimental Design in Petroleum Reservoir Studies

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Biography

Mohammad Jamshidnezhad is a Senior Reservoir Engineer who has worked (in Canada and Iran) for more than 14 years on carbonate and sandstone reservoirs and become specialized in reservoir engineering aspects of enhanced oil recovery (EOR), PVT, reservoir simulation and uncertainty assessments. He holds a PhD degree in chemical engineering from the University of Tehran (Iran). Mohammad was a Research Scholar in the Department of Petroleum Engineering at Curtin University of Technology in Australia in 2003 where he performed successful experiments on Enhanced Oil Recovery. He was employed as a postdoctoral researcher working on a simultaneous water and gas injection project at the Petroleum Engineering Section of the Department of Geoscience and Engineering at Delft University of Technology (The Netherlands) during 2007−2008. Mohammad has taught industry short courses in reservoir simulation, PVT, and uncertainty analysis. He is the author of several peer-reviewed journal and international conference papers.

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Preface

Petroleum reservoir engineering is one of the most attractive fields at universities and colleges since most graduates find good positions in petroleum companies and work in different disciplines like estimating hydrocarbon in-place, reserve, best enhanced oil recovery methods, and reservoir management.

One of the main duties for reservoir engineers is reservoir study, which starts when a reservoir is explored and continues until reservoir abandonment. Reservoir study is a continual process, which means after a period of production the study should be updated.

A reservoir study starts with reservoir characterization: that is, gathering data (geological, geophysical, drilling and production) and building a geological model. The geological model (fine model) is upscaled and then initialized subject to initial conditions of the reservoir. The dynamic model is run by a reservoir simulator and the model results are then compared with observed (field) data. This step of reservoir study is called history matching. If the comparisons are reasonable, the model behaves similarly to the actual reservoir and it is then used for predicting the future of the reservoir. Because of reservoir complexity and limited information and data, the reservoir characterization is not conducted completely and precisely. This means that uncertainties always exist in reservoir characterization and reservoir engineers cannot define (model) a reservoir deterministically. Uncertainty in reservoir modeling causes difficulties in reasonable history matching and prediction phases of study. Quantifying and analyzing uncertainties could relieve the difficulties.

The focus of this book is on experimental design to analyze and to quantify these uncertainties. The book is divided into four chapters. In Chapter 1, an introduction to petroleum reservoirs is presented. Reservoir modeling is discussed in Chapter 2. In Chapter 3, uncertainties in reservoir modeling and experimental design methods are explained, and finally six case studies are discussed in Chapter 4. Five cases are run using black-oil reservoir simulators, and a thermal reservoir simulator is used for the sixth case. The explained case studies cover a wide range of reservoir studies: two conventional petroleum reservoirs, a fractured carbonate reservoir, steam-assisted gravity drainage (SAGD) in a heavy oil reservoir, miscible water alternate gas (WAG) into a reservoir, and a hydraulically fractured shale-gas reservoir.

Last but not least, I would like to thank Prof. Mehran Pooladi-Darvish (Fekete Associate Inc.) for initiating the concept behind this book. I would also like to thank all Senior Reservoir Engineers at the Petroleum Engineering Department of National Iranian South Oil Company (NISOC) for providing some data of the second case study. Finally, I appreciate the editorial comments provided by Dr. Alireza Jamshidnejad.

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