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application of optimal control theory to enhanced oil recovery

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Application Of Optimal Control Theory To Enhanced Oil Recovery

Eduardo D. Sontag



Application Of Optimal Control Theory To Enhanced Oil Recovery:

Application of Optimal Control Theory to Enhanced Oil Recovery W. Fred Ramirez, 1987 *Application of Optimal Control Theory to Enhanced Oil Recovery* W. Fred Ramirez, 1987-01-01 In recent years enhanced oil recovery techniques have received much attention in the oil industry Enhanced oil recovery methods can be divided into three major categories thermal processes which include steam flooding steam stimulation and in situ combustion chemical processes which include surfactant polymer injection polymer flooding and caustic flooding and miscible displacement processes which include miscible hydrocarbon displacement carbon dioxide injection of large amounts of rather expensive fluids into oil bearing reservoir formations Commercial application of any enhanced oil recovery process relies upon economic projections that show a decent return on the investment Because of high chemical costs it is important to optimize enhanced oil recovery processes to provide the greatest recovery at the lowest chemical injection cost The aim of this book is to develop an optimal control theory for the determination of operating strategies that maximize the economic attractiveness of enhanced oil recovery processes The determination of optimal control histories or operating strategies is one of the key elements in the successful usage of new enhanced oil recovery techniques The information contained in the book will therefore be both interesting and useful to all those working in petroleum engineering petroleum management and chemical engineering

Optimal Control Leslie M. Hocking, 1991 Systems that evolve with time occur frequently in nature and modelling the behaviour of such systems provides an important application of mathematics These systems can be completely deterministic but it may be possible too to control their behaviour by intervention through controls The theory of optimal control is concerned with determining such controls which at minimum cost either direct the system along a given trajectory or enable it to reach a given point in its state space This textbook is a straightforward introduction to the theory of optimal control with an emphasis on presenting many different applications Professor Hocking has taken pains to ensure that the theory is developed to display the main themes of the arguments but without using sophisticated mathematical tools Problems in this setting can arise across a wide range of subjects and there are illustrative examples of systems from as diverse fields as dynamics economics population control and medicine Throughout there are many worked examples and numerous exercises with solutions are provided

Enhanced Oil Recovery, II E.C. Donaldson, G.V. Chilingarian, T.F. Yen, 1989-07-01 Written by foremost experts in the field and formulated with attention to classroom use for advanced studies in reservoir characterization and processes this book reviews and summarises state of the art progress in the field of enhanced oil recovery EOR All of the available techniques alkaline flooding surfactant flooding carbon dioxide flooding steam flooding in situ combustion gas injection miscible flooding microbial recovery and polymer flooding are discussed and compared Together with Volume I it presents a complete text on enhanced recovery technology and hence is an almost indispensable reference text This second volume compliments the first by presenting as complete an analysis as possible of current oilfield

theory and technology for accomplishment of maximum production of oil Many different processes have been developed and field tested for enhancement of oil recovery The emerging philosophy is that no single process is applicable to all petroleum reservoirs Each must be treated as unique and carefully evaluated for characteristics that are amenable to one or two of the proven technologies of EOR This book will aid the engineer in field evaluation and selection of the best EOR technology for a given oilfield Even the emerging technology of microbial applications to enhance oil recovery are reviewed and explained in terms that are easily understood by field engineers The book is presented in a manner suitable for graduate studies The only addition required of teachers is to supply example problems for class work An appendix includes a reservoir mathematic model and program for general application that can also be used for teaching

Computational Optimization and Applications in Engineering and Industry Xin-She Yang, Slawomir Koziel, 2011-06-19 Contemporary design in engineering and industry relies heavily on computer simulation and efficient algorithms to reduce the cost and to maximize the performance and sustainability as well as profits and energy efficiency Solving an optimization problem correctly and efficiently requires not only the right choice of optimization algorithms and simulation methods but also the proper implementation and insight into the problem of interest This book consists of ten self contained detailed case studies of real world optimization problems selected from a wide range of applications and contributed from worldwide experts who are working in these exciting areas Optimization topics and applications include gas and water supply networks oil field production optimization microwave engineering aerodynamic shape design environmental emergence modelling structural engineering waveform design for radar and communication systems parameter estimation in laser experiment and measurement engineering materials and network scheduling These case studies have been solved using a wide range of optimization techniques including particle swarm optimization genetic algorithms artificial bee colony harmony search adaptive error control derivative free pattern search surrogate based optimization variable fidelity modelling as well as various other methods and approaches This book is a practical guide to help graduates and researchers to carry out optimization for real world applications More advanced readers will also find it a helpful reference and aide memoire

Microbial Enhanced Oil Recovery E.C. Donaldson, G.V. Chilingarian, T.F. Yen, 1989-02-01 The use of microorganisms and their metabolic products to stimulate oil production is currently receiving renewed interest worldwide This technique involves the injection of selected microorganisms into the reservoir and the subsequent stimulation and transportation of their in situ growth products in order that their presence will aid in further reduction of residual oil left in the reservoir after secondary recovery is exhausted Although unlikely to replace conventional microbial enhanced oil recovery this unique process seems superior in many respects Self duplicating units namely the bacteria cells are injected into the reservoir and by their in situ multiplication they magnify beneficial effects This new approach to enhancement of oil recovery was initiated in 1980 and the first results were published in the proceedings of two international conferences This book evolved from these

conferences and was designed to encompass all current aspects of microbial enhanced oil recovery the development of specific cultures increase of the population for field application various methods for field applications and the results and the environmental concerns associated with this newly developed technology It provides a comprehensive treatise of the subject and is arranged to show the laboratory development of microbes suited to microbial enhanced oil recovery and the perpetuation of the special cultures in a petroleum reservoir Thus this book has specific usefulness in the laboratory the oilfield and the classroom Although not written as a text book it can be used as a reference volume for graduate studies in enhanced oil recovery

Mathematical Control Theory Eduardo D. Sontag, 2013-11-21 Mathematics is playing an ever more important role in the physical and biological sciences provoking a blurring of boundaries between scientific disciplines and a resurgence of interest in the modern as well as the classical techniques of applied mathematics This renewal of interest both in research and teaching has led to the establishment of the series Texts in Applied Mathematics TAM The development of new courses is a natural consequence of a high level of excitement on the research frontier as newer techniques such as numerical and symbolic computer systems dynamical systems and chaos mix with and reinforce the traditional methods of applied mathematics Thus the purpose of this textbook series is to meet the current and future needs of these advances and to encourage the teaching of new courses TAM will publish textbooks suitable for use in advanced undergraduate and beginning graduate courses and will complement the Applied Mathematics Sciences AMS series which will focus on advanced textbooks and research level monographs

v Preface to the Second Edition The most significant differences between this edition and the first are as follows Additional chapters and sections have been written dealing with nonlinear controllability via Lie algebraic methods variational and numerical approaches to nonlinear control including a brief introduction to the Calculus of Variations and the Minimum Principle time optimal control of linear systems feedback linearization single input case nonlinear optimal feedback controllability of recurrent nets and controllability of linear systems with bounded controls

Microbial Enhancement of Oil Recovery - Recent Advances E.C. Donaldson, 1991-04-03 This conference was instituted to examine field activities in Microbial Enhancement of Oil Recovery The U S Department of Energy has sponsored several field projects and the details from some of these were presented as well as a few from industry The balance of the program was concerned with new developments in research Today's oil production technology leaves one third to one half of the original oil in place in the reservoir at abandonment of secondary recovery waterflooding This leaves a very large target for microbial enhanced oil recovery which was shown by the research papers of this conference to be capable of producing up to 50% of the residual oil The field trials show that the normal projected oil production decline curve can be reversed or leveled off by microbial enhancement of oil recovery This conference has shown that a variety of applications are possible to correct oilfield problems as well as to enhance oil recovery Among these is the suppression of hydrogen sulfide production which alone is a tremendous advance because of the

large quantity of sour oil production If hydrogen sulfide production can be curtailed it would increase the value of the produced oil decrease its toxicity and largely decrease its corrosiveness All of these would be welcome both in the field and at the petroleum refinery where special precautions must be taken to process sour crude oil Another very important discovery is the ability of certain bacteria to eliminate paraffin deposition around the producing well and in the tubulars This is a welcome improvement for many producers who have considerable difficulty in controlling paraffin deposition

Microbial Enhancement of Oil Recovery - Recent Advances E.T. Premuzic, A. Woodhead, 1993-07-23 This volume is concerned with many aspects of petroleum microbiology and biochemistry all with strong commercial applications Worldwide research on the major topic MEOR Microbially Enhanced Oil Recovery is comprehensively covered under experimental work field applications and modeling The challenge of formulating a complete in situ MEOR system microorganisms nutrient package and other amendments is explored together with the future needs in the design and execution of this new biotechnology

Asphaltenes and Asphalts, 1 G.V. Chilingarian, T.F. Yen, 1994-09-08 This is the first volume of a two volume set of critical reviews of many aspects of both asphaltenes and asphalts and their interrelationship Asphaltene is invariably present in asphalt or bitumen and other fossil fuel derived liquids such as coal tar coal liquefaction products pyrolyzed shale oil from oil shales source rock extracts and numerous naturally occurring bituminous substances The latter include asphaltites asphaltoids waxes and carbonaceous deposits containing a composition of petroleum and coal The contents cover not only the basic science of asphaltene but also deal with the applications and technology such as upstreams production recovery and downstreams refining upgrading of petroleum and the paving technology and formulation preparation The main features of the book are it provides an up to date in depth review of every aspect of asphaltenes and asphalts it spans five decades of research and technology of heavy fractions of petroleum it presents a global view of asphaltene related to exploration production refining and upgrading The book will be welcomed as a valuable reference source for petroleum companies research institutes refineries universities and also by individuals dealing with the production origin formation engineering conversion and catalysis of heavy oil tar sands and other bituminous materials

Dynamic Systems Modelling and Optimal Control Victoria Miroshnik, Dipak Basu, 2016-04-29 Dynamic Systems Modelling and Optimal Control explores the applications of oil field development energy system modelling resource modelling time varying control of dynamic system of national economy and investment planning

Fundamentals of Gas Reservoir Engineering J. Hagoort, 1988-06-01 Gas reservoir engineering is the branch of reservoir engineering that deals exclusively with reservoirs of non associated gas The prime purpose of reservoir engineering is the formulation of development and production plans that will result in maximum recovery for a given set of economic environmental and technical constraints This is not a one time activity but needs continual updating throughout the production life of a reservoir The objective of this book is to bring together the fundamentals of gas reservoir engineering in a coherent and systematic manner It is intended both for students who are new

to the subject and practitioners who may use this book as a reference and refresher Each chapter can be read independently of the others and includes several completely worked exercises These exercises are an integral part of the book they not only illustrate the theory but also show how to apply the theory to practical problems Chapters 2 3 and 4 are concerned with the basic physical properties of reservoirs and natural gas fluids insofar as of relevance to gas reservoir engineering Chapter 5 deals with the volumetric estimation of hydrocarbon fluids in place and the recoverable hydrocarbon reserves of gas reservoirs Chapter 6 presents the material balance method a classic method for the analysis of reservoir performance based on the Law of Conservation of Mass Chapters 7 10 discuss various aspects of the flow of natural gas in the reservoir and the wellbore single phase flow in porous and permeable media gaswell testing methods based on single phase flow principles the mechanics of gas flow in the wellbore the problem of water coning the production of water along with the gas in gas reservoirs with underlying bottom water Chapter 11 discusses natural depletion the common development option for dry and wet gas reservoirs The development of gas condensate reservoirs by gas injection is treated in Chapter 12 Appendix A lists the commonly used units in gas reservoir engineering along with their conversion factors Appendix B includes some special physical and mathematical constants that are of particular interest in gas reservoir engineering Finally Appendix C contains the physical properties of some common natural gas components

Proceedings, 2002 Energy: a Continuing Bibliography with Indexes, 1980

Optimal Control of Switched Systems Arising in Fermentation Processes Chongyang Liu, Zhao Hua Gong, 2014-09-11 The book presents in a systematic manner the optimal controls under different mathematical models in fermentation processes Variant mathematical models i e those for multistage systems switched autonomous systems time dependent and state dependent switched systems multistage time delay systems and switched time delay systems for fed batch fermentation processes are proposed and the theories and algorithms of their optimal control problems are studied and discussed By putting forward novel methods and innovative tools the book provides a state of the art and comprehensive systematic treatment of optimal control problems arising in fermentation processes It not only develops nonlinear dynamical system optimal control theory and optimization algorithms but can also help to increase productivity and provide valuable reference material on commercial fermentation processes

Hydrocarbon Migration Systems Analysis J.M. Verweij, 1993-01-27 The main intention of this book is to provide geoscientists interested or working in hydrocarbon exploration with a comprehensive understanding of the evolution of hydrocarbon migration systems in sedimentary basins and to give guidelines for its application in basin evaluation For this purpose the book fully integrates hydrogeologic and hydrodynamic aspects of the evolution of sedimentary basins with petroleum geologic aspects It will be of interest to petroleum geologists hydrogeologists geochemists and reservoir geologists

The Practice of Reservoir Engineering L.P. Dale, 2013-10-22 The Practice of Reservoir Engineering has been written for those in the oil industry requiring a working knowledge of how the complex subject of hydrocarbon reservoir engineering can be applied in the field in a practical manner

The book is a simple statement of how to do the job and is particularly suitable for reservoir production engineers and is illustrated with 27 examples and exercises based mainly on actual field developments. It will also be useful for those associated with the subject of hydrocarbon recovery. Geoscientists, petrophysicists and those involved in the management of oil and gas fields will also find it particularly relevant. The new <http://www.elsevier.nl/locate/0444506705> Practice of Reservoir Engineering Revised Edition will be available soon.

A Practical Companion to Reservoir Stimulation M.J. Economides, 1992-01-03. This workbook is a practical companion to the second edition of the textbook Reservoir Stimulation. The two books are intended to be used together. This new volume should be particularly useful for the training of new engineers and petroleum engineering students as it contains approximately 100 problems and their solutions plus a lengthy chapter giving data necessary for designing a stimulation treatment. Chapters are included containing practical problems on reservoir and well considerations, rock mechanics, fracturing fluids and proppants, fracture calibration, treatments design and modeling of propped fractures, evaluation of fracture treatments, design of matrix treatments, diversion and treatment evaluation, design and performance of acid fractures and stimulation of horizontal wells. These chapters are labeled with letters from A to J to distinguish them from their companion chapters in Reservoir Stimulation. Equations, figures and tables from the textbook are referred to in the workbook but are not reproduced.

Decision Making Under Uncertainty Claude Greengard, Andrzej Ruszczyński, 2012-12-06. In the ideal world, major decisions would be made based on complete and reliable information available to the decision maker. We live in a world of uncertainties and decisions must be made from information which may be incomplete and may contain uncertainty. The key mathematical question addressed in this volume is how to make a decision in the presence of quantifiable uncertainty. The volume contains articles on model problems of decision making process in the energy and power industry when the available information is noisy and/or incomplete. The major tools used in studying these problems are mathematical modeling and optimization techniques, especially stochastic optimization. These articles are meant to provide an insight into this rapidly developing field which lies in the intersection of applied statistics, probability, operations research and economic theory. It is hoped that the present volume will provide entry to newcomers into the field and stimulation for further research.

JPT. Journal of Petroleum Technology, 1987-07

Whispering the Techniques of Language: An Mental Quest through **Application Of Optimal Control Theory To Enhanced Oil Recovery**

In a digitally-driven world wherever displays reign great and immediate transmission drowns out the subtleties of language, the profound techniques and mental nuances concealed within phrases usually move unheard. Yet, nestled within the pages of **Application Of Optimal Control Theory To Enhanced Oil Recovery** a fascinating literary treasure pulsing with natural emotions, lies an extraordinary journey waiting to be undertaken. Published by an experienced wordsmith, that charming opus encourages readers on an introspective journey, lightly unraveling the veiled truths and profound impact resonating within ab muscles cloth of each and every word. Within the emotional depths of this touching review, we shall embark upon a genuine exploration of the book is core subjects, dissect their charming writing design, and fail to the strong resonance it evokes strong within the recesses of readers hearts.

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Table of Contents Application Of Optimal Control Theory To Enhanced Oil Recovery

1. Understanding the eBook Application Of Optimal Control Theory To Enhanced Oil Recovery
 - The Rise of Digital Reading Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Advantages of eBooks Over Traditional Books
2. Identifying Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Application Of Optimal Control Theory To Enhanced Oil Recovery
 - User-Friendly Interface
4. Exploring eBook Recommendations from Application Of Optimal Control Theory To Enhanced Oil Recovery

- Personalized Recommendations
- Application Of Optimal Control Theory To Enhanced Oil Recovery User Reviews and Ratings
- Application Of Optimal Control Theory To Enhanced Oil Recovery and Bestseller Lists
- 5. Accessing Application Of Optimal Control Theory To Enhanced Oil Recovery Free and Paid eBooks
 - Application Of Optimal Control Theory To Enhanced Oil Recovery Public Domain eBooks
 - Application Of Optimal Control Theory To Enhanced Oil Recovery eBook Subscription Services
 - Application Of Optimal Control Theory To Enhanced Oil Recovery Budget-Friendly Options
- 6. Navigating Application Of Optimal Control Theory To Enhanced Oil Recovery eBook Formats
 - ePub, PDF, MOBI, and More
 - Application Of Optimal Control Theory To Enhanced Oil Recovery Compatibility with Devices
 - Application Of Optimal Control Theory To Enhanced Oil Recovery Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Highlighting and Note-Taking Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Interactive Elements Application Of Optimal Control Theory To Enhanced Oil Recovery
- 8. Staying Engaged with Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Application Of Optimal Control Theory To Enhanced Oil Recovery
- 9. Balancing eBooks and Physical Books Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Application Of Optimal Control Theory To Enhanced Oil Recovery
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Setting Reading Goals Application Of Optimal Control Theory To Enhanced Oil Recovery
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Application Of Optimal Control Theory To Enhanced Oil Recovery

- Fact-Checking eBook Content of Application Of Optimal Control Theory To Enhanced Oil Recovery
- Distinguishing Credible Sources

13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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