Nome completo do autor

TÍTULO:
SUBTÍTULO (SE HOUVER)

Tese presented to the Programa de ... in partial fulfillment of the requirements for the degree of ... in Engenharia de ....

Advisor: Prof. ..., PhD
Co-advisor: Prof. Dr. ...

Florianópolis

2015

Nome completo do autor

TÍTULO: SUBTÍTULO (SE HOUVER)

This Tese is recommended in partial fulfillment of the requirements for the degree of "... in Engenharia de ...", which has been approved in its present form by the Programa de ....

Florianópolis, April 29th 2015.

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Terceiro membro
Universidade ...
(Videoconferência)

Este trabalho é dedicado aos meus cole-
gas de classe e aos meus queridos pais.

ACKNOWLEDGEMENTS

Inserir os agradecimentos aos colaboradores à execução do trabalho. Inserir os agradecimentos aos colaboradores à execução do trabalho.

Texto da Epígrafe. Citação relativa ao tema do trabalho. É opcional. A epígrafe pode também aparecer na abertura de cada seção ou capítulo.

(Autor da epígrafe, ano)

RESUMO ESTENDIDO

O texto do resumo deve ser digitado, em um único bloco, sem espaço de parágrafo. O resumo deve ser significativo, composto de uma sequência de frases concisas, afirmativas e não de uma enumeração de tópicos. Não deve conter citações. Deve usar o verbo na voz passiva. Abaixo do resumo, deve-se informar as palavras-chave (palavras ou expressões significativas retiradas do texto) ou, termos retirados de thesaurus da área.

Palavras-chave: Palavra-chave 1. Palavra-chave 2. Palavra-chave 3.

ABSTRACT

Resumo traduzido para outros idiomas, neste caso, inglês. Segue o formato do resumo feito na língua vernácula. As palavras-chave traduzidas, versão em língua estrangeira, são colocadas abaixo do texto precedidas pela expressão “Keywords”, separadas por ponto.

Keywords: Keyword 1. Keyword 2. Keyword 3.

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

LIST OF SYMBOLS

p_{wf}	[Pa]	flowing pressure of the well at the bottomhole	25
q		liquid flow rate of the well	25

CONTENTS

1 INTRODUCTION

This chapter presents an overview of the purpose and focus of the study, its significance, and how it was conducted. Each of the following chapters is outlined at the end.

1.1 PROBLEM STATEMENT[1]

In the daily operation of an oil field many decisions have to be taken that affect the volume of fluids produced. A decision made by a production engineer or field operator takes into account the capacities of the surface facility in processing, storing, and exporting fluids, the pressures and fluid handling limits in subsea equipment, the restrictions coming from reservoir management, and all these are linked by production models that predict the production of the wells. Many studies have been carried out to propose mathematical tools that help the decision-makers to select the best production plan. A particular type of oil field operation is required when a gas-lift system is used, and there are several works that deal with this problematic including [1, 2, 3, 4, 5, 6, 7, 8]. Each of these studies suggests an approach to solve the daily production optimization problem considering an specific set of variables and constraints, among the many possible scenarios of optimization that arise when gas-lift is present. Although those approaches can consider variation in equipment operating conditions (e.g. failures and valves alignments) they all considered only nominal operating conditions of the wells which, despite being valid for a short time horizon, may vary significantly to the extent of compromising and even invalidating a nominal solution.

Uncertainty in production optimization problems could be found in the definition of the system capacities as well as in the production models. In the latter, the lack of accuracy to predict the system production arise from measurement errors, unmodeled oscillating behavior, and system trends evolving dynamically in time, which hinders the sampling of informative data. All happening in a time scale that could affect a daily production optimization solution. Few works have investigated manners of dealing with uncertainty in the scope of daily production optimization. The problem is in fact twofold: quantifying uncertain data [9], and handling the uncertainty in the optimization problems in order to provide a solution that is at least to some extent immune to data perturbation

[1] footnote text goes here

[10, 11, 12]. Besides the small number of studies on the latter issue, there is only one that to some extent considered uncertainty explicitly in the optimization problem [11], but only for few parameters.

To this end, this work presents a formulation for production optimization which can account explicitly for uncertainty that are inherent to production wells.

1.2 OBJECTIVES AND CONTRIBUTIONS

The research purpose is to develop production optimization models that can produce practical and robust solutions when the operative scenario faces uncertainty in the parameters that characterize reservoirs, wells, or equipment.

The proposed production optimization models are designed based on the theory developed for robust linear optimization [13, 14, 15, 16], extending and adapting it to the specific requirements of this application. The robust production optimization models have their solutions compared to standard production optimization models, which are based on nominal (i.e. expected value) parameter values, in order to highlight the benefits and drawbacks of the optimal robust solutions and to demonstrate the impact of using standard optimal solutions in an uncertain scenario. Experiments are performed by using synthetic but representative oil fields instantiated in a commercial simulator.

The main contributions of this work can be synthesized as:

- The development of a robust optimization methodology that can be applied to several instances of gas-lift optimization problems;

- An analysis of the performance of standard and robust production optimization to oil fields operating under uncertainty, using their optimal solutions in multiphase simulation softwares.

One central assumption of this work is that each uncertain parameter can be modeled as a range of possible values, not requiring a complicated description. Intuitively this provides an easier approach for modeling uncertainty, however, even finding relevant bounds for the parameter values remains a practical and theoretical challenge.

1.2.1 Organization of the dissertation

This dissertation is divided in six chapters and one appendix. Chapter 1 e Section 1.2.1 Gunnerud and Foss,Codas and Camponogara, Mixed-Integer Linear Programming (MILP), p_{wf}, q.

1.2.1.1 First final comments

That is it!

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SAMPLING ALGORITHM

Approximating a complicated function by piecewise functions is an alternative to reduce complexity. This is a common approach in optimization to create tractable versions of originally hard to solve problems. In this line, the most ordinary approach is to build piecewise-linear (PWL) functions, where in each interval a linear function is used to represent the original function. When the original function is well defined (with known derivatives), or at least has a mathematical description, many algorithms exist to find the appropriate breakpoints that define the intervals, and to designate their linear app

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