

Popular science summary of the PhD thesis

PhD student	Steen Hørsholt
Title of the PhD thesis	Operational Optimization of Oil Reservoirs in the Danish North Sea
PhD school/Department	DTU-Compute

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

This thesis is concerned with the application of optimal control theory to operational optimization of oil reservoir models. The operational optimization is part of a nonlinear model predictive control strategy (NMPC) for oil reservoirs management, which aims to maximize a long-term financial performance measure of the dynamics of a reservoir model. In a globalized world with continued high demand for oil and gas, unpredictable oil prices and stringent environmental regulations, the industry is seeking improved oil recovery methods that reduce financial risks and ensure a minimal environmental footprint. By intelligent utilization of known production technologies and already existing infrastructure, production optimization methods have the potential to improve the oil recovery factor for both new and mature oil and gas reservoirs and to ensure more sustainable production. The overall purpose of the work presented in this thesis is to bring the technology for oil production optimization forward to a level ready for industrial uptake. We focus on computing optimal open-loop control strategies for reservoir management by applying adjoint gradient-based methods for constrained optimization. The goal is to develop a framework that enables the application of optimal control to operational optimization of industrial-scale reservoir models. In order to achieve this goal, we combine novel as well as existing methods and strategies for oil production optimization together with well-established proven simulation software and state-of-the-art gradient-based software for constrained optimization.

The thesis has three main contributions:

- A hierarchical multigrid method, which enables the application of production optimization procedures to high-resolution reservoir models.
- A soft constraint penalty method for handling non-linear output constraints, e.g. upper bounds on phase flow rates.
- Software for oil production optimization of industrial-scale oil reservoir models. The software merges the versatility and robustness of well-established reservoir simulators with state-of-the-art gradient-based software for constrained optimization.

Please email the summary to the PhD secretary at the department