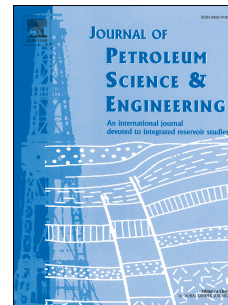


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Slugging attenuation using Non-Linear Model Predictive Control in offshore oil production

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Abstract: The increase in oil production in offshore systems can be achieved by active control, as state in the literature. However, the approach based on linear controllers has performance limitations in real applications, because of valve rate of change, as shown in this paper. As an evolution control approach, we show up the advantages of using a Nonlinear Model Predictive Controller (NMPC) by the Local Linearization on the Trajectory (LLT) algorithm, with the Fast Offshore Well Model (FOWM) as internal model, together with a first idea for tuning the controller parameters. Through a monovisible pressure control strategy, manipulating the production choke, we observed a potential production increase around 9.0% using NMPC. In addition, the multivariable advantage of NMPC strategy is stressed including the gas lift flow as a second manipulated variable. With this structure, it is possible to decrease the production choke variation in 76% and the oil production variability by 80% compared to monovisible structure, with similar production gain.

Keywords: slug flow, deepwater, offshore crude production, nonlinear model predictive control.

Highlights

- Show a control strategy using Nonlinear Model Predictive Controller (NMPC) with a first idea of controller tuning method applied to offshore production.
- Identify the potential increase of oil production based on model simulation using the Fast Offshore Well Model and how to active this with different control strategies.
- The evolution of the robustness from the Proportional Integral Derivative (PID) linear control to advanced process control method using a Nonlinear Model Predictive Controller (NMPC) by the Local Linearization on the Trajectory (LLT) algorithm.
- Show a realistic case of study than other papers considering the bounds of manipulated variables typical of offshore production choke valves.

1 INTRODUCTION

In Brazil, the petroleum industry has significant importance in the economy, and the Exploration and Production of Oil & Gas (E&P) as the heart of this sector is the key to this success [1]. Although in recent years the behavior of oil prices has undergone a sudden change due to a supply-demand imbalance and wrong political decisions, some risk consultants are still optimistic about the representativeness of oil in the Gross National Product [2], [3]. [4] estimates a 270% increase in production from 2011 to 2030. This fact has been validated by the oil production increase reported in the last

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