127ª DEFESA DE TESE EM ENGENHARIA INDUSTRIAL

PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA INDUSTRIAL - PEI

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Título: AN MPC AUTO-TUNING FRAMEWORK FOR TRACKING ECONOMIC GOALS OF ESP-LIFTED OIL WELLS

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Resumo:

The use of electrical submersible pumps (ESP) for oil lifting is a widely used method in the oil and gas industry to increase production. Therefore, controlling and optimizing this process to ensure stable and economical production is crucial, minimizing operational costs and maximizing production efficiency. A widely used technique to maximize performance, reduce costs, and define operational goals is real-time optimization (RTO). In order to adequately implement this techinique, it is necessary that the control layer works appropriately and is aligned with the challenges and requirements of the process. Recently, the literature has found excellent results using the advanced model predictive control (MPC) technique due to its ease of incorporating constraints and economic requirements into its formulation. Although it is a powerful technique, a reasonable definition of MPC parameters is necessary for its good operation; otherwise, the system may operate at suboptimal or ineficiente conditions. However, tuning the MPC controller is a complex problem requiring specialized knowledge to select controller parameters, such as prediction horizons, control horizons, and control weights. In addition, most of the literature tuning methods are dedicated to specific MPC formulations, performance, or robustness goals, not exploring the impact of tuning on economic indicators. So, it is a need for a generalized tuning method that works for different formulations, processes, and tuning requirements. Besides that, no studies in the literature investigate the effect of MPC tuning on the optimization and operation of ESP-lifted wells, whether by performance, robustness, or economic criteria. Therefore, a generalized MPC tuning method is presented, based on an online receding horizon optimization algorithm capable of encompassing different MPC formulations, constraints, and tuning criteria, from performance to economics. This method provides a new perspective for the online optimization of ESP-lifted oil wells, explicitly addressing the MPC tuning problem. The results show that the proposed approach has potential for the oil and gas industry since it was possible to test different case studies and control formulations in simulated results, achieving a 5.7% improvement in oil production or a 2.1% reduction in energy consumption, depending on the desired criteria.

Palavras-chaves: MPC controllers, MPC Tuning, Economic Tracking, ESP-lifted wells

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