Optimization with Time-periodic PDE Constraints: Numerical Methods and Applications

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Abstract: Optimization problems with time-periodic parabolic PDE constraints can arise in important chemical engineering applications, e.g., in periodic adsorption processes. We present a novel direct numerical method for this problem class. The main numerical challenges are the high nonlinearity and high dimensionality of the discretized problem. The method is based on Direct Multiple Shooting and inexact Sequential Quadratic Programming with globalization of convergence based on natural level functions. We highlight the use of a generalized linear iterative splitting approach with a novel two-grid Newton-Picard preconditioner for the solution of the quadratic subproblems. We further present numerical results for application problems, including a Simulated Moving Bed process from chemical engineering.

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