

A Diagonalization-Based Parallel-in-Time Preconditioner for Instationary Flow Control Problems

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PDE-constrained optimization problems arise in various applications in industry and can also be useful in other mathematical fields. Applications can be found in physics, chemistry, biology, medical imaging, optimal transport, and many other areas. Due to the lack of analytical solutions to these problems in general, the fast and robust numerical solution is of utmost importance. However, the discretization of such problems often results in huge-scale systems of linear or possibly also non-linear equations. Black-box solvers, such as direct solvers for linear systems, often fail when applied to these systems. During recent years, preconditioned iterative methods have been successfully applied to a range of PDE-constrained optimization problems, including large-scale flow control problems, on which we focus here.

In this talk, we will explore a diagonalization-based approach to create effective preconditioners for a range of problems, including unsteady Stokes and Oseen control. Our methodology involves approximating the original problem by a time-periodic equivalent, allowing us to perform a temporal diagonalization. This results in a parallel-in-time preconditioner tailored for solving complex flow control problems. Our approach demonstrates robustness with respect to model parameters and the discretization.