THE UNIVERSITY OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

Numerical Analysis Seminar

Optimal Control Design for Fluid Mixing: from Open-Loop to Closed-Loop

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Abstract

The question of what velocity fields effectively enhance or prevent transport and mixing, or steer a scalar field to the desired distribution, is of great interest and fundamental importance to the fluid mechanics community. In this talk, we mainly discuss the problem of optimal mixing of an inhomogeneous distribution of a scalar field via active control of the flow velocity, governed by the Stokes or the Navier-Stokes equations. Specifically, we consider that the velocity field is steered by a control input that acts tangentially on the boundary of the domain through the Navier slip boundary conditions. This is motivated by mixing within a cavity or vessel by rotating or moving walls. Our main objective is to design a Navier slip boundary control for achieving optimal mixing. Non-dissipative scalars governed by the transport equation will be our main focus. In the absence of molecular diffusion, mixing is purely determined by the flow advection. This essentially leads to a nonlinear control and optimization problem. A rigorous proof of the existence of optimal open-loop control and the first-order necessary conditions for optimality will be addressed. Moreover, a feedback law (sub-optimal) will be also constructed based on interpolation of the optimality conditions. Finally, numerical experiments will be presented to demonstrate our ideas and control designs.

Date:	December 16, 2022 (Friday)
Time:	16:30pm – 17:30pm
Venue:	Room 210, Run Run Shaw Building, HKU. ZOOM: https://hku.zoom.us/j/ Meeting ID: 913 6532 3891 Password: 310656

All are welcome