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Optimal Neumann Control for the Steady-state 2D Navier-Stokes Equations

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Let $B \subset R \subset \mathbb{R}^2$, B be a bounded domain, R be a rectangle, $\Omega = R \setminus B$. In Ω we consider steady-state 2D Navier-Stokes equation with given fluid velocity on the left vertical side of R, Neumann condition $\partial_n v - pn|_{R_1} = 0$, $\partial_n v - pn|_{\Gamma_i} = u_i, i = 1, 2$ on the right vertical side R_1 of R and on the open subsets Γ_i of the horisontal sides of R. On the rest part of the the boundary $\partial\Omega$ the no-slip condition holds. Here v is velocity of the fluid, p is the pressure, n is outer normal to $\partial\Omega$. This boundary value problem simulates liquid flowing around the body B in a tube R when one can influence on the process by the control $u = \{u_1, u_2\}$ from $\Gamma = \Gamma_1 \cup \Gamma_2$. An optimal control problem, the minimization of drag by means of control u is considered when some additional restrictions on v in a subdomain of Ω are imposed.

Existence of the solution for discribed problem, and derivation of the corresponding optimality system will be discussed.

The talk is based on the joint work with R.Rannacher [1].

[1] A. V. Fursikov, R. Rannacher *Optimal Neumann Control for the Two-dimensional Steady-state Navier-Stokes equations// Advances in mathematical Fluid Mechanics, "'New directions in mathematical fluid mechanics"'*, Burkhauser Verlag Basel/Switzerland 2009. P. 193–221.