A shape optimization problem for Navier-Stokes flows in three-dimensional tubes

Michael Hintermüller [1], Axel Kröner[2], Hong Nguyen[3]

[1]WIAS Berlin
[2]WIAS Berlin
[3]WIAS Berlin, nguyen@wias-berlin.de

In order to optimize the shape design of air ducts in combustion engines, we consider a shape optimization problem subject to the Navier- Stokes equations in three dimensions with mixed boundary conditions on domains of polyhedral type. An inflow profile is given at the inlet, a no-slip boundary condition is imposed on the wall, and a no-friction boundary condition on the outlet. To find optimal shapes, we choose a cost functional to achieve a uniform outflow and to minimize the total pressure loss. The associated numerical solution requires an efficient computation and yet accurate approximation of an adjoint-based shape gradient in a shape-gradient-related descent method.
Keywords: Shape optimization, Navier-Stokes equations, adjoint-based method.