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Topology optimization for turbulent flow with RANS model

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Abstract

This research developed a new finite element (FE) based topology optimization (TO) for turbulent flow with the Reynolds-Averaged Navier-Stokes (RANS) equations. Despite many innovative researches on the subject of fluidic TO, it is rare to consider the influence of turbulent flow in TO. To consider the effect of complex turbulent fluid motion, this research considered the RANS model developed mainly for aerodynamic flows. For a successful TO, it is one of issues to modify the turbulent model taking account into topological evolutions during an optimization process. To address this issue, we proposed to add the penalization terms to the original governing equations. To show the validity of the present approach and the effect of turbulent flow on optimal layouts, some two dimensional benchmark designs studied for laminar flow are reconsidered. It was also found that the balance between the inertia force and the viscosity force plays an important role in topological designs.