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Airflow optimization to prevent transmission of COVID-19 SALEH NABI, Mitsubishi Elec Res Lab, C. P. CAULFIELD, BP Institute & DAMTP, University of Cambridge — Motivated by attempts to reduce the spread of disease during the pandemic, we investigate modifications to HVAC systems. Our aim is to minimise airborne droplet transport through optimization of ventilation and design of airflow patterns within the buildings. Thus, we consider the optimization of turbulent flows within enclosed environments using the so-called one-shot method for adjoint-based optimization. We use the incompressible Reynolds-averaged Navier-Stokes (RANS) equations, derive the corresponding adjoint equations and solve the resulting sensitivity equations with respect to inlet conditions. For validation, we solve a series of inverse-design problems, for which we recover known globally optimal solutions. We then solve the maximal mixing problem for a passive scalar in a region of interest, as representative of potentially infected droplet transfer between occupants, with minimum energy budget. The role of an approximate Hessian as a preconditioner as well as tuned step-size for the one-shot method iterations are highlighted. It is shown, by employing an efficient optimization algorithm, that the one-shot method can solve the PDE-constrained optimization problem with a cost comparable, (about fourfold) to that of a single iteration of the simulation problem alone.

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