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Low order modelling for feedback control of fluid flows around complex geometries OLIVER DELLAR, BRYN JONES, University of Sheffield, DEPARTMENT OF AUTOMATIC CONTROL AND SYSTEMS ENGINEERING COLLABORATION — The majority of goods transportation vehicles' power is consumed in overcoming aerodynamic drag. Reduction in pressure drag via feedback control could have significant economic and environmental effects on CO_2 emissions, and reduce fatigue on the body by suppressing vortex shedding. The difficulty in designing such controllers lies in obtaining models suited to modern control design methods, which are necessarily of much lesser complexity than typical Computational Fluid Dynamics (CFD) models, or models derived from immediate spatial discretisation of the Navier-Stokes equations. This work develops an approach for modelling fluid flows using frequency response data generated for individual computational node sub-systems that result from a CFD type spatial discretisation of the governing equations. Input-to-sensor frequency response data for the overall system are then computed by forming interconnections between adjacent nodes via a Redheffer Star Product operation, from which one typically observes low-order dynamics. With this data, a low-order model can be identified and used for controller design. This method avoids manipulating large matrices and is therefore computationally efficient and numerically well-conditioned. It can be readily applied to complex geometry flows.

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