What is the 'correct' formulation of the linearised Navier-Stokes equations for designing feedback flow control systems? OLIVER DELLAR, BRYN JONES, The University of Sheffield, ACSE COLLABORATION — The use of feedback control is looking increasingly attractive as a means of reducing the pressure drag which acts upon bluff body vehicles such as heavy goods vehicles, and thus reducing both fuel consumption and CO_2 emissions. Motivated by the need to efficiently obtain low-order models of such flows in order to utilise model based control theory, we consider the effect on system dynamics of basing the plant model on different formulations of the linearised Navier-Stokes equations. The dynamics of a single computational node's subsystem which arises upon spatial discretisation of the governing equations in both primitive variables and pressure Poisson equation formulations are considered, revealing fundamental differences at the nodal level. The effects of these differences on system dynamics at the full fluid flow system level are exemplified by considering the corresponding formulations of a two-dimensional channel flow, subjected to a number different of boundary conditions. This ultimately reveals which formulations of the governing equations are suitable for feedback control design, and which should be avoided.

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