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Phase-space dynamics of opposition control in wall-bounded turbulent flows[1] YONGYUN HWANG, JOSEPH IBRAHIM, QIANG YANG, PATRICK DOOHAN, Department of Aeronautics, Imperial College London — The phase-space dynamics of wall-bounded shear flow in the presence of opposition control is explored by examining the behaviours of a pair of nonlinear equilibrium solutions (exact coherent structures), edge state and life time of turbulence at low Reynolds numbers. While the control modifies statistics and phase-space location of the edge state and the lower-branch equilibrium solution very little, it is also found to regularise the periodic orbit on the edge state by reverting a period-doubling bifurcation. Only the upper-branch equilibrium solution and mean turbulent state are significantly modified by the control, and, in phase space, they gradually approach the edge state on increasing the control gain. It is found that this behaviour results in a significant reduction of the life time of turbulence, indicating that the opposition control significantly increases the probability that the turbulent solution trajectory passes through the edge state. Finally, it is shown that the opposition control increases the critical Reynolds number of the onset of the equilibrium solutions, indicating its capability of transition delay.

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