Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Stabilisation of exact coherent structures using time-delayed feedback in two-dimensional turbulence.[1] DAN LUCAS, Keele University — Time-delayed feedback control (Pyragas 1992 *Phys. Letts. A* **170**(6) 421-428), is a method known to stabilise periodic orbits in chaotic dynamical systems. A system $\dot{\mathbf{x}}(t) = f(\mathbf{x})$ is supplemented with $G(\mathbf{x}(\mathbf{t}) - \mathbf{x}(\mathbf{t} - \mathbf{T}))$ where G is a 'gain matrix' and T a time delay. The form of the delay term is such that it will vanish for any orbit of period T, making it an orbit of the uncontrolled system. This non-invasive feature makes the method attractive for stabilising exact coherent structures in fluid turbulence. Here we validate the method using the basic flow in Kolmogorov flow; a two-dimensional incompressible viscous flow with a sinusoidal body force. Linear predictions are well captured by direct numerical simulation. By applying an adaptive method to adjust the streamwise translation of the delay, a known travelling wave solution is able to be stabilised up to relatively high Reynolds number. Finally an adaptive method to converge the period T is also presented to enable periodic orbits to be stabilised in a proof of concept study at low Reynolds numbers. These results demonstrate that unstable ECSs may be found by timestepping a modified set of equations, thus circumventing the usual convergence algorithms.

[1]This work is supported by EPSRC New Investigator Award EP/S037055/1.

Dan Lucas
Keele University

Date submitted: 31 Jul 2020 Electronic form version 1.4