# Locality and Nonlocality in Turbulence: An Approach to Understanding the Dynamics of the Velocity Gradient Tensor

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Abstract

A key technical challenge to the Navier-Stokes equations, in addition to their nonlinear nature, is their non-locality, which is a consequence of the way that the pressure and velocity are coupled. Given that the small scales in the flow are typically conceptualised in terms of the velocity derivatives (rather than the velocity itself), understanding the cascade of turbulence towards dissipation can be usefully formulated in terms of the velocity gradient tensor (VGT). This is of practical relevance as accurate models for the dynamics of the VGT have potential use as closure models in computational fluid dynamics. However, the viscous forces and pressure (now the pressure Hessian) result in complications to any simple model. I will present an alternative approach to considering these dynamics that separates the local and non-local dynamical contributions. One consequence of this approach is that a tight bound (for incompressible flow) can be used to determine how large the non-local term can be relative to the local dynamics. We can then use simulations to study the physics of the flow very close to this bound to gain an understanding of how local and non-local processes interact.

Biography

Chris was appointed to a Chair at Loughborough University in 2018. Previously he was a Prize Senior Lecturer (2010-2018) at The University of Sheffield and a Lecturer at The University of Leeds (2000-2010). He has a PhD from Cambridge, a MSc from British Columbia and a BA from Oxford. In 1997, between his MSc and PhD, he worked for the Icelandic Meteorological Office.