Homotopy between plane Couette flow and Pipe flow

MASATO NAGATA, Tianjin University, KENGO DEGUCHI, Imperial College, London —

In order to investigate symmetry connections between two canonical shear flows, i.e. plane Couette (PCF) and pipe flow (PF), which are linearly stable for all Reynolds numbers and therefore undergo subcritical transition, we take annular Poiseuille-Couette flow (APCF) as an intermediary. Although PCF and PF are very different geometrically, APCF recovers PCF by taking the narrow gap limit, and also PF by taking the limit of vanishing inner cylinder where a homotopy of the basis functions from no-slip to regular conditions at the centre is considered. We show that the double-layered mirror-symmetric solutions in sliding Couette flow (APCF without axial pressure gradient) found by Deguchi & Nagata (2011) can be traced back to the mirror-symmetric solutions in PCF. Also we show that only the double-layered solution successfully reaches the PF limit, reproducing the mirror-symmetric solution in PF classified as M1 by Pringle & Kerswell (2007).

Masato Nagata
Tianjin University

Date submitted: 21 Jul 2014