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Streamwise Constant Dynamics in Plane Couette Flow[1] DENNICE GAYME, BEVERLEY J. MCKEON, California Institute of Technology, BASSAM BAMIEH, University of California, Santa Barbara, ANTONIS PAPACHRISTODOULOU, University of Oxford, JOHN C. DOYLE, California Institute of Technology — We have previously shown that when forced by small-amplitude Gaussian noise, a streamwise constant projection of the Navier Stokes equations captures many of the salient features of fully developed turbulent plane Couette flow. In this work we develop further the relationship between the nonlinearity in the model and the mathematical mechanism that results in the characteristic shape of the turbulent velocity profile. We use periodic spanwise-wall normal stream functions to represent an idealized model of the streamwise streaks and vortices that are thought to play an important role in both transition and fully developed turbulence in wall bounded shear flows. We demonstrate that using this model, such stream functions produce mean flows consistent with both DNS and experimental observations. Analysis of the amplification properties of the model around flow solutions arising from such stream functions is also studied in an effort to develop a quantitative bound on their energy contribution.

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