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Direct numerical simulation of the fully developed turbulent boundary layer[1] MELISSA KOZUL, DANIEL CHUNG, Univ of Melbourne — The term 'fully developed' is commonly applied to channel and pipe flows that are statistically stationary in time and no longer exhibit streamwise development. Following the temporal turbulent boundary layer simulation of Kozul, Chung & Monty (*J. Fluid Mech.*, vol. 796, 2016, pp. 437-472) where streamwise development was removed with periodic boundary conditions, we now remove the remaining development in time, giving a turbulent boundary layer that is 'fully developed' at finite Reynolds numbers. This is achieved by rescaling in the wall-normal direction and assuming arrested boundary-layer growth, motivated by a large-eddy turnover time estimated to be much shorter than the growth time scale of the boundary-layer. Analysis of outer-layer similarity shows that this setup, with only one additional computational term, gives a dominant balance equivalent to the high-Reynolds number asymptotics for both the spatially and temporally developing turbulent boundary layers. Our idealised, but non-physical simulation thus allows us to enforce the infinite Reynolds number dominant balance assumptions commonly made at finite Reynolds numbers. This simple setup could be used to generate inflow conditions for spatial simulations, or as a test case for model development and analysis.

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