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On a new class of unstable skewed 3D modes for plane canonical shear flows[1] ALPARSLAN YALCIN, YASIN TURKAC, MARTIN OBERLACK, Technische Universitat Darmstadt, CHAIR OF FLUID DYNAMICS TEAM — We conduct a linear stability analysis of the Asymptotic Suction Boundary Layer. For this case the resulting Orr-Sommerfeld equation allows for an exact analytic solution in terms of hypergeometric functions and, in turn, the related boundary conditions give rise to an algebraic eigenvalue problem (EVP), which has to be solved numerically. A remarkable feature was uncovered when expanding the EVP for asymptotically small streamwise wave numbers and large Reynolds number, where the expanded EVP yields solutions only in the distinguished limit when the product of the latter numbers is finite. This finding may provide an analytical link to the emergence of large-scale turbulent structures in plane shear flows at the presence of large Reynolds numbers. We further present the existence of novel "skewed" 3D stability modes in plane shear flows. The methodology to obtain these modes is obtained by extending the classical Squire transformation of 2D to 3D modes by assuming not only stream- but also spanwise spatial growth/decay. We can show that a new class of skewed unstable 3D modes are obtained even for canonical flows which are known to be modally stable, e.g. plane Couette flow.

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