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Linear stability analysis of swirling turbulent flows with turbulence models[1] VIKRANT GUPTA, MATTHEW JUNIPER, University of Cambridge — In this paper, we consider the growth of large scale coherent structures in turbulent flows by performing linear stability analysis around a mean flow. Turbulent flows are characterized by fine-scale stochastic perturbations. The momentum transfer caused by these perturbations affects the development of larger structures. Therefore, in a linear stability analysis, it is important to include the perturbations' influence. One way to do this is to include a turbulence model in the stability analysis. This is done in the literature by using eddy viscosity models (EVMs), which are first order turbulence models. We extend this approach by using second order turbulence models, in this case explicit algebraic Reynolds stress models (EARSMs). EARSMs are more versatile than EVMs, in that they can be applied to a wider range of flows, and could also be more accurate. We verify our EARSM-based analysis by applying it to a channel flow and then comparing the results with those from an EVM-based analysis. We then apply the EARSM-based stability analysis to swirling pipe flows and Taylor-Couette flows, which demonstrates the main benefit of EARSM-based analysis.

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