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Mathematical Singularity Behaviour of Turbulent Transition HUA-SHU DOU, BOO CHEONG KHOO, National University of Singapore — In our previous work, a criterion for turbulent transition has been proposed which is expressed by an energy gradient function which is the ratio of the transverse energy gradient and the streamwise energy loss of unit volumetric fluid in the base flow. Further, the threshold of the disturbance amplitude obtained is scaled with the Reynolds number by an exponent of -1, which is in agreement with the experimental results for pipe flow. In the present study, we show that turbulent transition can be excited via a singularity of the energy gradient function. This singularity of the energy gradient function corresponds to the case of infinite Re. When a laminar flow is stable (at low Re), the energy gradient function is located remotely from the mentioned singularity. It is found that the role of disturbance introduced to a laminar flow is to promote the energy gradient function to approach the singularity. When the Reynolds number is sufficiently large, a large disturbance may trigger the energy gradient function to enter the singularity. Once this function is trapped into this singularity, the fluid flow becomes increasingly "chaotic" tending towards the turbulent state. For the occurrence of the singularity, the amplitude of disturbance needs to reach a certain threshold for a given Reynolds number. These findings are in agreement with those in the literature.

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