Three-dimensional sub critical transition in a separated flow.

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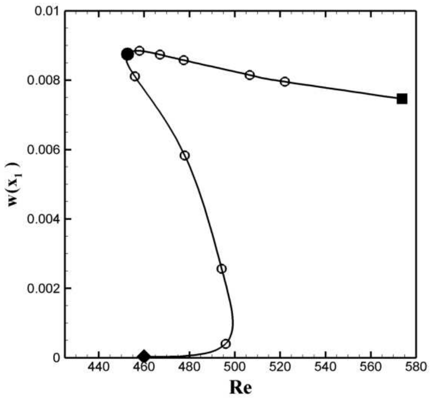
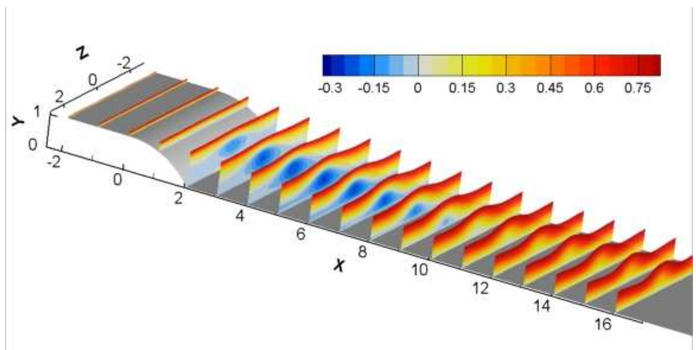
ABSTRACT

This work is a numerical study of the transition process in separated flows. In recent years global stability analyses of several separated flow configurations [1, 2, 3] have shown that the first unstable global mode is steady and three-dimensional. This suggests that the flow bifurcates from a two-dimensional steady state to a three-dimensional steady state.

To further explore the nature of the bifurcation a weakly nonlinear analysis has been performed in the case of a smooth backward-facing step. It will be shown that the steady bifurcation at Re=498 is sub critical. In the vicinity of this Reynolds number the amplitude of the three-dimensional steady global mode is governed by a fifth-order Stuart-Landau equation whose coefficients may be computed to obtain the bifurcation diagram. Those results, their validity and limits will be discussed. To further investigate the transition process, the global stability of the three-dimensional steady flows has been investigated using periodic boundary conditions in the transverse direction. It will be shown that a second bifurcation occurs at Reynolds number Re=470, the flow bifurcating from a three-dimensional steady state to a three-dimensional unsteady periodic state.





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