On the Stabilization of Tollmien-Schlichting Waves by Means of Streamwise Streaks

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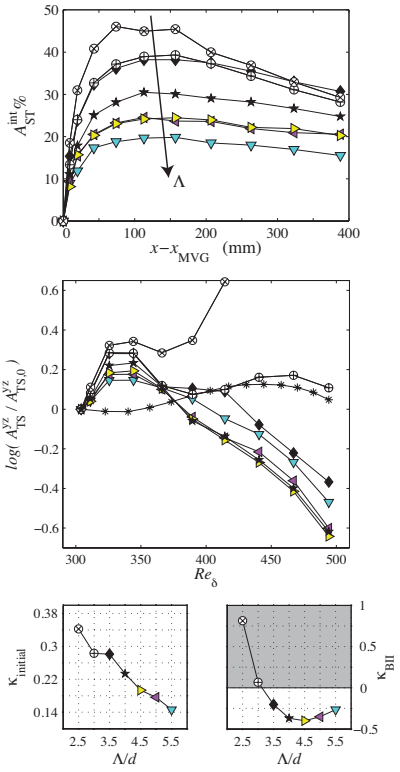
It is well known that the skin-friction coefficient can increase by an order of magnitude in a turbulent boundary layer compared to a laminar one for high enough Reynolds numbers, therefore, delaying transition to turbulence plays an important role in reducing the skin-friction drag on any aerodynamically smooth body. The conventional belief regarding the stability of wall bounded shear flows is that it highly correlates with the roughness of the surface in contact with the fluid, i.e. the smoother the surface is the longer it will remain laminar. However, recent investigations have shown that well designed *roughness elements*, if mounted on the surface in the boundary layer, can control the flow and delay the transition to turbulence by modulating the base flow in the spanwise direction. By mounting circular surface roughness elements on a flat plate for base flow modulations in the spanwise direction, it has been shown that the growth of Tollmien-Schlichting (TS) wave disturbances may be damped, strongly enough such that transition to turbulence delay may be obtained. In the present study we compare the effectiveness of circular surface roughness elements compared to miniature vortex generators (MVGs) to damp the growth of TS waves. Furthermore, we investigate how different geometrical parameters of the MVGs affect the streamwise evolution of the streaks. In the figure the effect of varying the spanwise distance between individual MVG pairs (Λ/d) is shown, both on the TS wave growth curves (middle) and the streak amplitude evolution (top).



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