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The law of incipient separation for turbulent flows as inferred by RANS DAWEI LU, ABHIRAM AITHAL, ANTONINO FERRANTE, University of Washington, Seattle — We have performed Reynolds-averaged Navier-Stokes (RANS) computations of incompressible turbulent boundary layer with adverse pressure gradient over two-dimensional smooth curved ramps of length L for $982 \leq Re_\theta \leq 3698$. First, we have validated the RANS by comparing the results with the experiments of Song & Eaton (*Expts. Fluids*, 2004) for the separated flow over an arc at $Re_\theta = 1100$. Then, we have investigated the effects of the ramp slope and curvature on the skin-friction and pressure coefficients. Our results show a numerical criterion of incipient flow separation determined only by the geometrical parameters of maximum slope, $|z'|_{max}$, length, L, and height, h, of the ramp, and by Re_L. Specifically, incipient separation occurs when $|z'|_{max}$ normalized by $\tilde{h} = h/L$ ($|\hat{z}'|_{max} = |z'|_{max}/\tilde{h}$) reaches a critical value that is determined according to the following law: $|\hat{z}'|_{crit} = \alpha \tilde{h} Re_L^{-1/10} + \beta$, where $\alpha < 0$ and $\beta > 0$ are constants. Accordingly, the flow separates over a curved smooth ramp for which $|\hat{z}'|_{max} > |\hat{z}'|_{crit}$. The uncertainty of the law is also reported.

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