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Separated shear-layer instability reproduction by a Reynolds stress model of turbulence SUAD JAKIRLIC, ROBERT MADUTA, Darmstadt University of Technology — A boundary layer separating from a solid wall transforms into a 'separated shear layer' exhibiting a broader frequency range. Such a highly-unsteady shear layer separating the mean stream from the flow reversal is dominated by the organized, large-scale coherent structures, influencing to a large extent the overall flow behavior. Unlike in the case of a flat-plate boundary layer separating at a fixed point characterizing a backward-facing step geometry, which can be reasonably well captured by a statistical model of turbulence, the separation process pertinent to continuous curved surfaces as well as some fence- or rib-shaped configurations is beyond the reach of any RANS (Reynolds-Averaged Navier Stokes) model independent of the modeling level. The latter issue motivated the present work, dealing with an appropriate extension of a near-wall Second-Moment Closure (SMC) model towards an instability-sensitive formulation. The production term in the corresponding scale-supplying equation is selectively enhanced through introduction of the ratio of the first to the second derivative of the velocity field, the latter representing the integral part of the von Karman length scale, enabling appropriate capturing of the fluctuating turbulence and accordingly the reproduction of the separated shear-layer instability. The analysis is performed by simulating the flow separated from a fence, an axisymmetric hill and a cylinder configuration.

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