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Scaling Laws for Flow Control in a Hump Diffuser. CIRO CERRETELLI, GE Global Research Center — A study has been performed to characterize the effects of steady boundary layer injection on the separated flow of a hump diffuser. Results of parametrically varying discrete hole blowing characteristics have identified two separate regimes where the injection momentum coefficient and velocity ratio, respectively, are the primary scaling parameters for pressure recovery. Both discrete hole and slot injection have been investigated under varying degrees of adverse pressure gradient in the stream-wise direction, indicating optimal discrete hole injection to be more efficient than slot injection in terms of necessary injection momentum coefficient to achieve maximum levels of increased pressure recovery. The effects of discrete injection parameters such as hole diameter, hole spacing and stream-wise injection (yaw) angle have been studied. Angled injection (45° yaw) has been shown to be most effective in removing separated flow and increasing the pressure recovery. The angled injection enhances shear layer mixing through large-scale co-rotating vortical motion induced by the yawed jet – main flow interaction. A CFD/data comparison study has been performed on the results of the discrete injection tests, capturing overall data trends and representing the net impact of stream-wise and angled injection on pressure recovery in the hump diffuser.

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