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Three-Dimensional Spillage Effects on the Pressure Distribution of a Double Ramp

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Abstract : Double ramp geometry is widely used in supersonic and hypersonic environments as it presents unique flow patterns for shock wave-boundary layer interaction studies as well as for two-dimensional inlets and deflected control surfaces for re-entry vehicles. Hence, the surface pressure distribution is critical for optimum design. Though when the model is wide enough on spanwise direction the flow can be regarded as a two-dimensional flow, in actual applications a finite width would normally cause some three-dimensional spillage effects. No research has been found addressed this problem, hence the primary interest of this study is to set up a liable surface pressure distribution on a double ramp with three-dimensional effects. Both numerical and experimental (pressure sensitive paints) are applied to obtain the pressure distribution; the results agree well except that the numerical computation doesn't capture the Gortler vortices. The pressure variations on the spanwise planes are used to analyse the development of the Gortler vortices and the effects of three-dimensional spillage on the vortices. Results indicate that the three-dimensionl spillage effects not only enhance the developing of the Gortler vortice, but also increase the periodic distance between vortice pairs.

Keywords : spillage effects, pressure sensitive paints, hypersonic, double ramp
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