2D Inverse Heat Transfer Measurements by IR Thermography in Hypersonic Flows

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Abstract

The purpose of this work is to develop a data reduction technique for the measurement of heat fluxes in hypersonic flows. When dealing with inverse heat transfer problems in which temperature gradients in the solid are high enough (e.g. in case of temperature distributions due Görtler vortices that can have high spatial frequency), tangential conduction is not negligible. The heat flux is estimated by solving a 2-D inverse heat transfer problem. The heat flux distribution is represented by discrete Fourier series, to reduce the computational cost.The data reduction technique has been numerically validated and then applied to experimental tests performed in an hypersonic wind tunnel at Mach number equal to 7.5 on a compression ramp where the instability is generated using a comb-like strip. The heat flux obtained solving the 2-D inverse heat transfer problem is compared with the one obtained solving the 1-D problem to evaluate the effect of the tangential conduction. Results show that the convective heat flux coefficient distribution obtained by the 2-D solution is higher than the one obtained from the 1-D case and that, using the two dimensional approach, a higher resolution of the result is obtained.

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