Liu, Tianshu; **Wang, Bo**; **Rubal, Justin**; **Sullivan, John P.**

Correcting lateral heat conduction effect in image-based heat flux measurements as an inverse problem. (English) Zbl 1209.80034

Int. J. Heat Mass Transfer 54, No. 5-6, 1244-1258 (2011).

Summary: The image deconvolution method is developed, which is coupled with the one-dimensional (1D) analytical inverse method to calculate more accurate heat flux fields by correcting the lateral heat conduction effect in image-based surface temperature measurements. The theoretical foundation is a convolution-type integral equation with a Gaussian filter (kernel) that relates a heat flux field obtained by using the 1D inverse method on a surface to the true heat flux field. The accuracy of this method is evaluated and the standard deviation in the Gaussian filter is determined for different materials through simulations. This method is used to calculate heat flux fields in temperature-sensitive-paint measurements on a 7°-half-angle circular cone at Mach 6 in a short-duration hypersonic wind tunnel. In addition, a simple method is proposed to solve a projection problem associated with image deconvolution for a highly curved developable surface.

MSC:

80A23 Inverse problems in thermodynamics and heat transfer
80A20 Heat and mass transfer, heat flow (MSC2010)
80-05 Experimental work for problems pertaining to classical thermodynamics

Keywords:

image-based heat flux measurement; temperature sensitive paint; lateral heat conduction; integral equation; deconvolution; hypersonic flow

Software:

IHEAT

Full Text: DOI

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