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Surface Pressure Distributions for a Forebody Using Pressure Sensitive Paint

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Abstract : Pressure sensitive paint (PSP), which relies on the oxygen quenching of a luminescent molecule, is an optical technique used in wind-tunnel models. A full-field pressure pattern with low aerodynamic interference can be obtained, and it is becoming an alternative to pressure measurements using pressure taps. In this study, a polymer-ceramic PSP was used, using toluene as a solvent. The porous particle and polymer were silica gel (SiO_2) and RTV-118 (3g:7g), respectively. The compound was sprayed onto the model surface using a spray gun. The absorption and emission spectra for Ru(dpp) as a luminophore were respectively 441-467 nm and 597 nm. A Revox SLG-55 light source with a short-pass filter (550 nm) and a 14-bit CCD camera with a long-pass (600 nm) filter were used to illuminate PSP and to capture images. This study determines surface pressure patterns for a forebody of an AGARD B model in a compressible flow. Since there is no experimental data for surface pressure distributions available, numerical simulation is conducted using ANSYS Fluent. The lift and drag coefficients are calculated and in comparison with the data in the open literature. The experiments were conducted using a transonic wind tunnel at the Aerospace Science and Research Center, National Cheng Kung University. The freestream Mach numbers were 0.83, and the angle of attack ranged from -4 to 8 degree. Deviation between PSP and numerical simulation is within 5%. However, the effect of the setup of the light source should be taken into account to address the relative error.

Keywords : pressure sensitive paint, forebody, surface pressure, compressible flow
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