DFA Dirección de Formación Académica

CENTRO DE INVESTIGACIONES EN OPTICA, A.C.

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Tesis: " OPTIMIZATION OF A HELMHOLTZ RESONATOR FOR COOLING, BY THE SCHLIEREN TECHNIQUE"

Resumen:

Experimental and simulation work is carried out to investigate and measure temperature variation of a Helmholtz resonator using the imaging techniques, Background Oriented Schlieren (BOS) and Fringe Deflection (FD). This research project contains the theoretical, numerical and experimental analysis of temperature measurement using optical methods. A comparison of the performance of temperature measurements between the two experimental techniques, Background Oriented Schlieren (BOS) and Fringe Deflection (FD) is reported. Both methods are based on measuring refractive index field gradients using a background image captured with a digital camera.

The object to be examined is placed between the background image and the digital camera.

The BOS (Background Oriented Schlieren) technique is a newly established method for simple and inexpensive visualizing of refractive index gradient, temperature and density variation in compressible flows. The BOS design setup mainly consists of a background with randomly placed dots and a camera targeted on the dots. Variations between the uninterrupted image and the distorted image resulted in the dots displacement which is used by the optical flow method to create a displacement field. Fringe Deflection uses vertical fringes instead of the dotted background.

The results obtained show that Fringe Deflection is more efficient. The FD was then used to analyze a Helmholtz resonator. In the Helmholtz resonator experiment, a pulsed synthetic air jet is generated and directed onto a surface to be cooled. The results show that the relatively cooler air expelled from the resonator cavity interacts with the warmer air in the heated plate and cools the heated plate slightly. Since the cooling air is expelled again and again at a certain frequency, the process is repeated and cooler air is pumped to the hot plate.