UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF ENGINEERING, SCIENCE & MATHEMATICS

SCHOOL OF ENGINEERING SCIENCES

Doctor of Philosophy

THE ATTENUATION OF FLOW-INDUCED TONAL NOISE USING PLASMA ACTUATORS

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The noise produced by low speed flows over cavities with and without plasma actuators were studied using experimental techniques. The acoustic and flow environments of open cavities with length-depth ratios of 0.5, 1.0, 2.0 and 3.0 have been investigated. Measurements using oil flow, particle imaging velocimetry, boundary layer surveys and surface mounted microphone measurements were taken. Experiments were conducted in a low speed wind tunnel running at freestream velocities between 10 m/s and 20 m/s corresponding to Reynolds numbers, based on the depth of the cavity, of 3.6×10^4 to 7.1×10^4.

An array of paraelectric plasma actuators were located on the approaching surface to the cavity, aligned with the direction of the oncoming flow. Results show that the paraelectric plasma actuators can produce a significant attenuation of the dominant cavity mode. The particle imaging velocimetry surveys around the electrode elements reveal vortical structures produced by the plasma actuators. It is shown that these structures convect downstream with the mean flow and produce disturbances similar to that of vortex generators. This affects the convection of spanwise discrete vortices in the cavity shear layer, disrupting the mechanisms that allow the cavity to produce tones. Results also show that for any given geometry and freestream flow speed the attenuation of the dominant mode reduced with increasing voltage to the actuators.