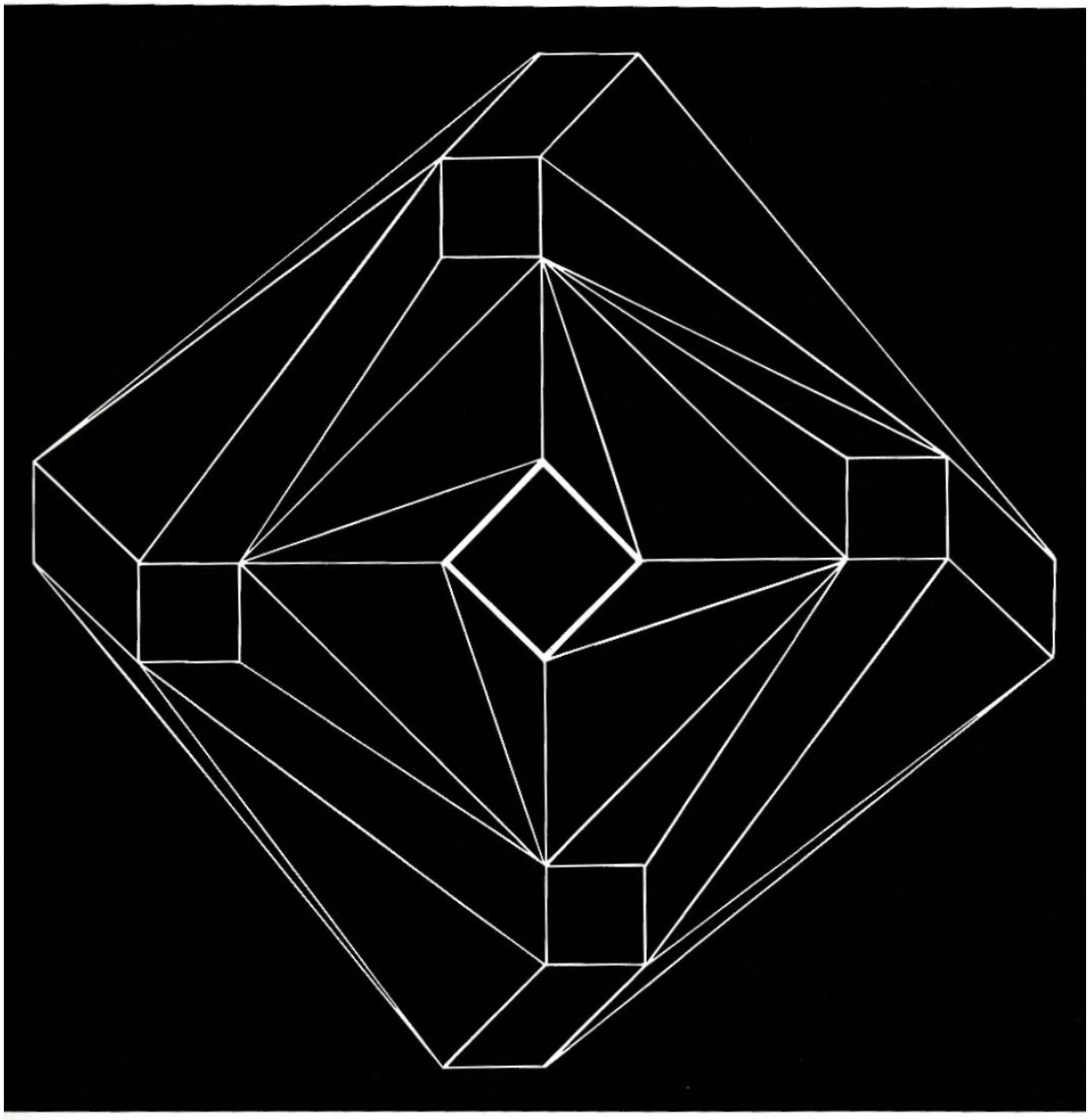
THEORETICAL AND APPLIED MECHANICS

Volume 28

Proceedings of the 28th Japan National Congress for Applied Mechanics, 1978

Edited by Japan National Committee for Theoretical and Applied Mechanics Science Council of Japan

UNIVERSITY OF TOKYO PRESS



Jet-Wing/Flap Interaction Noise from External Upper Surface Blowing Configuration

Masataka MAITA

National Aerospace Laboratory, Science and Technology Agency, Chofu, Tokyo

The acoustic characteristics of the external upper surface blowing (USB) concept of a powered high lift device (PHLD) are studied experimentally using 8%-scale static model. Observations of exhaust jet flow attachment and spreading characteristics on wing/flap surface are also carried out using several flow visualization techniques.

Noise reduction data were obtained by optimizing basic jet nozzle-wing/flap structural geometries for the lowest noise. Among the associated parameters which define USB-PHLD configurations, (i) the location relative to wing/flap and the shape of the exhaust jet nozzle and (ii) flow attachment devices are important parameters. Flow characteristics dependence on these parameters and PHLD noise were also obtained.

From far-field noise spectra, OASPL dependence on jet velocity and coherence across near-field surface pressure, it was concluded that the flap trailing edge noise was the most predominant noise source. Several acoustically treated flaps and serrated trailing edge design techniques were applied to attenuate edge noise.

I. INTRODUCTION

External upper surface blowing is one of the primary concepts in achieving powered high lift for Short Takeoff and Landing (STOL) aircraft applications. The powered lift augmentation during takeoff and approach is derived by deflecting turbo-fan engine exhaust jet adjacent to the wing/flap upper surface by Coanda effect. From the acoustic view point, this design concept produces additional noise as jet exhaust flow interacts with wing/flap surface. From the morphology of past studies, the resulting STOL aircraft noise sources would be qualitatively categorized as the schematics of Fig. 1.

In order to meet the stringent noise level goals which are being put forth and community acceptance, noise reduction techniques must be developed. While the state of the art on this subject is advancing, the details of the actual noise-generating and radiation mechanisms are not yet known. For this purpose, a noise program was carried out experimentally to obtain extensive USB-PHLD noise data comparing with the visualization of jet flow over wing/flap surface with 8%-scale static model. In the present paper, we attempt to summarize the main results and conclusions concerning the following properties:

(I) USB-PHLD noise characteristics;
(II) the location of the predominant noise source;
(III) PHLD noise dependence on jet flow characteristics relating to noise-generating mechanism;
(IV) USB-PHLD configuration system optimization for lowest noise; and
(V) flap trailing edge noise reduction techniques.

When discussing noise reduction and optimization data, we restrict ourselves mainly to