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Experimental Design for Research on Shock-Turbulence Interaction

A report has been made of the design of a series of experiments to investigate the production of acoustic waves in the interaction of a supersonic shock and a turbulence environment. The investigation is envisioned in five stages: apparatus design, development of instrumentation, preliminary experiment, turbulence generator selection, and main experiments.

The assumption of weak interaction is followed in the discussion of turbulence, which allows the field to be regarded as a composite of fluctuating vorticity, entropy, and acoustic modes. Primary interest is focused on the acoustic mode.

Since the interaction of a shock wave with any of these modes results in the production of all three modes, an accurate prediction of the resulting acoustic field is very difficult, because knowledge of the inter-mode correlation is required. Thus, in order to achieve reliable experimental results that may be compared with theoretical predictions, a fairly precise definition of the interacting turbulent stream is required. Production of such a well-known turbulence field is a primary goal of the experimental program.

In order to achieve this goal, it will be necessary to develop and use fluctuating static pressure probes, hot-wire anemometer systems, and their recording apparatus, so that the turbulence environment may be examined. Once this is completed and the experimental apparatus has been assembled, a preliminary experiment will be performed. A boundary layer turbulence field will be interacted with the plane shock wave of a supersonic wedge. Besides verifying that the acoustic waves generated by the shock-turbulence are observable, this experiment will be used to test and perfect the instrumentation.

In the fourth stage of the program, a turbulence generating device will be selected to produce an isotropic field of known mode content and decay features. This field will completely fill the cross section of the wind tunnel at the site of the experiment. Finally, in the fifth stage, an experimental investigation of the interaction of this well-known turbulence field with a shock wave will be conducted. Pressure fluctuations arising from the interaction at various downstream points will be the principal object of measurement, but the hot-wire anemometer will be used to define changes in the vorticity and entropy components of the turbulence as it passes across the shock.

Notes:

1. This experimental design is in the conceptual stage only. As of the date of publication of this Tech Brief, no apparatus has been constructed and no experimental results have been obtained.
2. The following documentation may be obtained from:

The Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151
Single Document price \$3.00
(or microfiche \$0.65)

Reference: NASA CR-61994 (N68-35786), Experimental Program for the Investigation of Transonic Flow Around Protuberances in the AEDC-16T Wind Tunnel Facility

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: S. W. Radcliffe, of
Wyle Laboratories
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