Wind noise reduction using a two microphone array

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Session GG. Noise V: Noise Measurement, Generation and Assessment

Gilles Daigle, Chairman

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Chairman's Introduction—9:30

Contributed Papers

9:35

GG1. Effect of directivity on the sound field produced by a source above a reflecting plane. J. B. Moreland (Westinghouse Research and Development Center, Pittsburgh, PA 15235)

In describing equipment sound emissions, it is desired to measure its noise radiation spectra with the equipment located in an anechoic or reflection-free environment. In practice, however, there are a number of situations where sound measurements are made with the equipment in hemi-anechoic space, in which case the equipment is located on a reflecting plane, but in an otherwise reflection-free environment. One problem associated with measurements made in hemi-anechoic environments is that the sound spectra measured under these conditions are not necessarily the same as the spectra that would be produced by the source in the absence of the reflecting plane. Investigators have sought to reconstruct the spectra that would be measured in anechoic space from measurements of spectra made with the source in a hemi-anechoic environment by assuming the equipment to be a point source located above a reflecting plane. In this paper, we examine the effect of directivity on measurements made in a hemi-anechoic environment by computing and measuring the sound field produced by a collinear array of five point sources. Our results show that source directivity has a considerable effect on the radiated sound pressure levels. Finally, the maximum sound pressure levels occur when the major lobe in the source directivity is directed toward the reflecting plane.

9:50

GG2. Effects of inlet flow conditions on discrete-tone noise generated by axial flow devices. K. B. Washburn and G. C. Lauchle (Applied Research Laboratory, The Pennsylvania State University, P.O. Box 30, State College, PA 16804)

The effect of upstream obstructions on the discrete-frequency noise generation of small, axial-flow fans is investigated. These cooling fans, which operate at very low Mach numbers, generate discrete tones through fluctuating blade-lift forces. These dipolelike acoustic sources are a direct consequence of nonuniformities in the velocity inflow field interacting with the rotor blades. In typical applications, several types of protuberances act to disrupt the inflow. Three basic types of obstructions are modeled. These include cylindrical, rectangular, and periodic structures. The fans operate in an otherwise free, anechoic environment. On-axis, farfield sound pressure level data are obtained through narrow-band spectral analysis. Levels at the blades passage frequency and several prominent harmonics are presented as functions of the nondimensionalized distance of the various obstructions from the rotor hub. Regions critical to noise reduction are determined as aids to the designer. [Work supported by IBM Corporation.]

10:05

GG3. Effects of amplitude (AM) and phase modulation (PM) on the coherence of rotating sources. David M. Yeager (International Business Machines Corporation, Department C18, Building 704, P.O. Box 390, Poughkeepsie, NY 12602)

Noise source identification in turbomachinery often requires estimation of the correlation between multiple rotating (aerodynamic) sources and the stationary radiated sound field. When treated as a multiple input/output problem, relative motion between input (sources) and output signals has the effect of amplitude and phase, modulating the input. The resulting nonlinearities introduced into the system affect the estimation of the coherence function. A straightforward approach will be used to examine the AM and PM effects as they pertain to the multiple input/output model for rotating sources. As pointed out in the literature on rotating diffuser models [Elko, M.S. thesis, Pennsylvania State University (1980)], source directivity plays a significant role in determining the strength of the AM spectra. This point is best illustrated by comparing the results of rotating monopoles and dipoles, and extrapolating these results to other radiation patterns. The consequences of PM are viewed through the general Doppler formula, applied to the specific geometry of rotating sources in an arbitrary plane with respect to a fixed observer. The possibility of removing the AM/PM effects by prepossessing the signals will also be discussed.

10:20

GG4. Modal analysis used to visualize the acoustic response of a pump. R. P. Kendig (Westinghouse Research and Development Center, Pittsburgh, PA 15235)

An air model is used to investigate potentially damaging pulsation responses of a pump. The internal cavity responses in an air model of the pump are determined. The methods commonly used in vibration modal analysis are applied to determine the acoustic modes of oscillation. This technique determines the internal response by exciting a volume of air inside the pump and proving its interior with two small microphones. Linear transfer functions are then computed and used to visualize some of the natural motion of air in various internal sections of the pump. Standing waves are established in accordance with the geometry of the test facility and the pump and its cavities and channels. The response of the pump interior is partially governed by the impeller and diffuser combination.

10:35

GG5. Wind noise reduction using a two microphone array. Daniel F. Marshall (USA-CERL, Environmental Division, P.O. Box 4005, Champaign, IL 61820)

The effectiveness of a method for wind noise reduction by cross correlation of the outputs of two vertically spaced microphones was studied. Average wind noise reduction was calculated for several microphone spacings and sample lengths; improvement in noise level on the order of 8 dB was achieved for 1-s samples with microphones spaced 31 cm apart, with better performance for longer samples and greater spacings. Correlation of acoustic signals was also investigated.

10:50

GG6. On the technical application of loudness meters. Eberhard Zwicker (Institute of Electroacoustics, Technical Unviersity of Munich, Arcisstr. 21, 8000 Munich 2, Federal Republic of Germany)