Effect of silent periods having short or long durations on the annoyance of vehicle sounds

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11:45

5aNS10. Effect of silent periods having short or long durations on the annoyance of vehicle sounds. Niek J. Versfeld, Joos Vos, and Frank W. M. Geurtsen (TNO Human Factors Res. Inst., P.O. Box 23, 3769 ZG Soesterberg, The Netherlands)

Two laboratory experiments were performed to study the effect on annoyance of noise concentration in time. The first (rating-scale) experiment dealt with the influence on annoyance of short-time silent periods (varying from 0 to 160 s) in pass-by vehicle noise of 240-s total duration. Results showed that, at a fixed equivalent sound level, and with the number of vehicles kept constant, annoyance hardly depended on the duration and position in time of the silent period. In the second experiment subjects had to compare the annoyance of road traffic sounds with that of sounds from heavy vehicles (such as tanks). In deciding which fragment was more annoying, the subjects had to imagine that they were exposed to the road traffic sounds throughout the year, whereas the sounds of heavy vehicles were only audible during a certain part of the day, week, or year. Results indicate that, at a given equivalent sound level, concentration of the sounds in time reduces annoyance. [Work supported by the Ministry of Defence.]

FRIDAY MORNING, 2 DECEMBER 1994 SABINE ROOM, 8:15 TO 11:45 A.M.

Session 5aPA

Physical Acoustics: Scattering and Elastic Wave Propagation

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Contributed Papers

8:15

5aPA1. Eigenfunction and eigenvalue analysis of scattering operators. T. Douglas Mast and Robert C. Waag (Dept. of Elec. Eng., Univ. of Rochester, Rochester, NY 14627)

Acoustic scattering by a given inhomogeneity can be compactly described by a scattering operator. This operator acts on the transmitted acoustic field to yield the scattered acoustic field on a measurement surface. For scattering at fixed frequency, the operator is known to admit a basis of eigenfunctions. When a finite number of transmit angles and receiving points is considered, the scattering operator can be represented as a matrix with an associated basis of eigenvectors. The present paper reports an investigation of the relationship between these eigenfunctions, eigenvectors, and associated eigenvalues and the characteristics of scattering objects, including their location, size, shape, orientation, and strength. Scattering operators are derived analytically for axisymmetric scatterers such as cylinders; in this case, the eigenfunctions of the operators take on simple trigonometric forms. Connections are noted between the eigenvalues and eigenfunctions of the scattering operators and the basis functions that appear in orthogonal function representations of the scattered fields. Scattering matrices for arbitrary scatterers are calculated using a coupled finite-element/integral equation method due to Kirsch and Monk [IMA J. Num. Anal. (to appear)]. Examples of the relationship between scatterer properties and eigenvalues and eigenvectors of the scattering matrix are presented.

8:30

5aPA2. Evidence for the existence of strong bending modes for signals scattered at oblique incidence from spheroidal shells. M. F. Werby (Naval Res. Lab., Code 7181, Stennis Space Center, MS) and N. A. Sidorovskaia (Univ. of New Orleans, New Orleans, LA)

In an earlier work [Werby *et al.*, J. Acoust. Soc. Am. **85**, 2365 (1989)] it was established that bending (flexing) modes are excited for signals scattering at oblique incidence from solid spheroidal shells. This was accomplished by comparing the exact T-matrix resonance predictions with those predicted from Timoshenko beam theory which accurately predicts the bending modes of a bar. One must then ask, do such modes exist for shells? One would expect that for fairly thick shells such modes do, but do they exist for thin shells too? In this study scattering of acoustical signals from elastic shells of various materials, aspect ratios, and shell thicknesses are examined. The study does indeed demonstrate the presence of bending modes even for very thin shells. It is interesting that for thick shells the resonance's manifest themselves as maximum amplitude returns while for thin shells they manifest themselves as minimum amplitude returns. The effect with the transitional nature of a rigidlike background is associated to a softlike background for the two extremes so that the return signals vary in their coherence from adding constructively to adding destructively over the thickness variation. The sensitivity of resonance locations as a function of the elastic parameters is also presented. [Work sponsored by NRL and ONR.]

8:45

5aPA3. Do pseudo-Scholte resonances exist? M. F. Werby (Naval Res. Lab., Code 7181, Stennis Space Center, MS) and N. A. Sidorovskaia (Univ. of New Orleans, New Orleans, LA)

In a pioneering work Talmant *et al.* [J. Acoust. Soc. Am. **86**, 278 (1989)] established the presence of pseudo-Stonely resonances excited when acoustical signals scatter from shells at or near coincidence frequency. This notion was supported by the argument that Stoneley waves exist at the fluid–elastic interface of a plate when water is on one side and the other side is evacuated. It is known that nondispersive waterborne waves are excited at the fluid–water interface for that case in the frequency region around coincidence frequency. This coincided with the bounded shell case in which very narrow strong resonances corresponded with the waterborne waves and a broad envelope function corresponded with the onset of the flexural resonances which become manifest at coincidence frequency when the flexural waves become supersonic and thus radiated into the water. The envelope effect corresponds to an abrupt phase change of pressure at coincidence frequency. An analogous argument predicts the existence of pseudo-Scholte resonances. The analog for that case is a plate in which fluids of like properties exist on both sides. In that case waterborne waves exist over the entire frequency range. The implication is that if one scatters from such an object there should be a proliferation of waterborne waves and thus for closed shells an abundance of resonances associated with waterborne waves circumnavigating the shell should by present. Can the abundance of sharp peaks excited on fluid filled shells be explained in terms of this mechanism? This issue is examined and the question is answered. [Work sponsored by NRL and ONR.]

9:00

5aPA4. The study of pulse signals from elastic spheroidal shells near reflecting interfaces. N. A. Sidorovskaia (Dept. of Phys., Univ. of New Orleans, New Orleans, LA), Cleon Dean (Georgia Southern Univ.,