

11:45

**2aPA13. Effects of heat conduction in wall on thermoacoustic wave propagation in a gas-filled, channel subject to temperature gradient.** Nobumasa Sugimoto and Hiroaki Hyodo (Dept. of Mech. Sci. Graduate School of Eng. Sci., Univ. of Osaka, Toyonaka, Osaka 560-8531, Japan, sugimoto@me.es.osaka-u.ac.jp)

This paper examines effects of heat conduction on acoustic wave propagation in a gas-filled, channel subject to temperature gradient axially and extending infinitely. Within the narrow-tube approximation in the sense that a typical axial length is much longer than a channel width, the system of linearized equations for the gas supplemented by the equation for heat

conduction in the solid wall is reduced to a thermoacoustic-wave equation for excess pressure uniform over the cross-section. This is the one-dimensional equation taking account of the wall friction and the heat flux at the wall surfaces given in the form of hereditary integrals. This equation is derived rigorously under the narrow-tube approximation, and is valid for any form of disturbances. The effects of heat conduction appear in the form proportional to the square root of the product of the ratio of the heat capacity per volume of the gas to that of the solid, and the ratio of the thermal conductivity of the gas to that of the solid. Although the product is very small usually, which endorses validity in neglect of the heat conduction, it is revealed that there are situations in which its effects are enhanced, depending on geometry and materials.

TUESDAY MORNING, 1 NOVEMBER 2011

ROYAL PALM 5/6, 8:00 TO 11:35 A.M.

### Session 2aSA

## Structural Acoustics and Vibration and Architectural Acoustics: Extraction of Information from Correlations of Random Vibrations

Earl G. Williams, Cochair

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### Invited Papers

8:00

**2aSA1. Extracting the earth response from noise and complex earthquake data.** Roel Snieder, Nori Nakata, Kees Wapenaar, and Evert Slob (Ctr. for Wave Phenomena, Colorado School of Mines, CO 80401 rsnieder@mines.edu)

Theory shows that when random noise is generated in proportion to the local dissipation rate, one can extract the response of a system from correlations of field measurements of such noise. Such a condition of equilibrium is rarely satisfied for elastic waves of the earth. Yet the earth response can be extracted from measured noise. We show examples of the retrieval of P-waves and of S-waves. The latter type of waves are retrieved from traffic noise in an urban environment. Since the traffic noise is excited by localized sources (road and railroads), it displays strong amplitude variations. In order to compensate for such amplitude variations, we use cross-coherence rather than cross-correlations for the data processing. We also analyze complicated waveforms excited by earthquakes to create maps of the shear-wave velocity in Japan and show that the shear wave velocity changes with time; this velocity drops throughout northeastern Japan with about 5% after the recent Tohoku-Oki earthquake. Our measurements show that the shallow subsurface in Japan weakens after the earthquake over a region about 1 200 km wide.

8:25

**2aSA2. Green's function retrieval from noise by multidimensional deconvolution.** Kees Wapenaar, Joost van der Neut, Evert Slob (Dept. of Geotechnol., Delft Univ. of Technol., Stevinweg 1, 2628CN Delft, The Netherlands, c.p.a.wapenaar@tudelft.nl), and Roel Snieder (Colorado School of Mines, Golden, CO 80401-1887)

The correlation of noise at two receivers is approximately proportional to the Green's function between these receivers. The approximation is accurate when the medium is lossless and the noise field is equipartitioned. These assumptions are in practice often violated: the medium of interest is often illuminated from one side only, the sources may be irregularly distributed and losses may be significant. For those situations, the correlation function is proportional to a Green's function with a blurred source. The source blurring is quantified by a so-called point-spread function which, like the correlation function, can be derived from the observed data (i.e., without the need to know the actual sources and the medium). The blurred source can be focused by multidimensionally deconvolving the correlation function for the point-spread function. We illustrate the correlation and deconvolution methods with several examples and discuss the advantages and limitations of both methods.