Session 5aNS

Noise and Physical Acoustics: Prediction and Propagation of Outdoor Noise I

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Chair's Introduction—7:30

Invited Papers

7:35

5aNS1. Sound field modeling in a street canyon with a diffusion equation. Judicaël Picaut, Stéphane Colle, and Michel Bérengier (LCPC, Section Acoustique Routière et Urbaine, Rte. de Bouaye, BP 4129, 44341 Bouguenais Cedex, France)

The transport theory of sound particles is applied to the sound field modeling in an empty street canyon with partially diffusely reflecting facades. A diffusion equation is then derived to predict the sound field distribution and the sound decay in the street. The main parameter, namely the diffusion coefficient, is a function of the street width and the acoustic reflection laws of both building facades. For a single rectangular street, analytical solutions can be found. For more complex urban spaces, a finite-element based approach is proposed. Several numerical examples are given, like the sound propagation in a street with a nonuniform cros section, and in street intersections, for point and line sources. In comparison with ray-tracing-based models, the diffusion model requires less computation time and could be applied to the calculation of a sound map for large urban areas. However, at the present time, the diffusion coefficient can be calculated only for simple building reflection laws, like the Lambert's one.

7:55

5aNS2. Prediction of road traffic noise using two-dimensional numerical analysis. Shinichi Sakamoto (Inst. of Industrial Sci., The Univ. of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, sakamo@iis.u-tokyo.ac.jp), Akinori Fukushima (NEWS Environ. Design, Inc., Hyougo, Kobe 652-0802), Tomonao Okubo, and Kohei Yamamoto (Kobayasi Inst. of Physical Res., Kokubunji, Tokyo 185-0022, Japan)

For acoustically complicated road structures such as semi-underground roads and special areas in which a viaduct road and a flat road with noise barriers exist together, prediction of road traffic noise is complicated because of multiple reflections and diffractions that occur inside the road structures. For such road structures, an energy-based engineering model cannot be applied and noise propagation should be addressed through introduction of wave theory. When the road structures have almost identical cross-sectional shape along the road, two-dimensional (2-D) wave-based numerical analyses are applicable. In the prediction model of road traffic noise, the ASJ-RTN Model 2003, published by the Acoustical Society of Japan (ASJ), the application of 2D wave-based numerical analysis was introduced as a prediction method for such complicated road structures. Comparisons between calculations by BEM and FDM and field measurements and experiments for three actual road structures were conducted. Consequently, calculation results agreed well with measured ones. Therefore, the validity of the calculation methods was confirmed. This research was discussed in the Research Committee of Road Traffic Noise in ASJ. Measurement data were provided by Nippon Expressway Company and the Nagoya Expressway Public Corporation.

8:15

5aNS3. Modeling outdoor sound propagation in mountainous areas. Dick Botteldooren, Timothy Van Renterghem, and Bram de Greve (Acoust. Group, Dept. of Information Technol., Ghent Univ., St. Pietersnieuwstraat 41, 9000 Gent, Belgium, dick.botteldooren@ugent.be)

Detailed modeling of outdoor sound propagation in mountainous area imposes special requirements. The strong gradients in ground surface create propagation conditions that may lead to noise levels much higher than expected at some distance from the source partly due to a focusing effect. Meteorological conditions are particular: main winds following the valley, strong temperature gradients often including stable inversion, slope winds, etc. Because of these particular conditions, efficient modeling of outdoor sound propagation in mountainous area requires adaptations to be made to general purpose models. In this paper we will present possibilities for making time-domain models terrain following and consider options to decrease the memory requirements. For the higher frequency range and distances one is generally interested in, these adaptations are insufficient. Hence, a Green's function parabolic equation model is added to the toolbox. To tackle the problem in three dimensions, a number of two-dimensional slices connecting the receiver point to all (segments of) sources considered is made. Propagation results for each slice are added. Numerical simulations are compared to field measurements made close to an Alpine highway.

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