OUTDOOR SOUND PROPAGATION

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SUMMARY

The reality of sound propagation outdoors is more complicated than simple geometrical spreading above a flat hard ground. Most common grounds, such as grass covered ground and layers of snow, are acoustically soft. This implies a complex reflection coefficient leading to a measured spectrum that is strongly influenced by the type of ground surface between source and receiver. Grounds may not be flat, leading to shadow zones or alternatively multiple reflections at the ground. Gradients of wind and temperature refract sound either upwards (upwind or in a temperature lapse) or downwards (downwind or in a temperature inversion), also leading to shadow zones or multiple reflections, respectively. Atmospheric turbulence causes fluctuations and scatters sound into acoustical shadow zones. Many of these features mutually interact and accurate predictions of sound transmission from source to receiver must somehow account for all of these phenomena simultaneously. Thus for example, ISO 9613 Part 2 in wide use today, attempts to account for all the phenomena empirically. In recent years the application of numerical techniques has led to significant advances. This plenary will review the various phenomena. Emphasis will be put on field measurements and simple physical interpretations. In a few cases, the predictions of ISO 9613 Part 2 will be compared with physical or numerical models.

In recent years a number of review articles and book chapters have appeared in print and give a detailed summary of outdoor sound propagation. Thus no attempt is made here to write more material. For a detailed general review see Embleton and Daigle (1994) or Sutherland and Daigle (1997). For a tutorial on outdoor sound propagation see Embleton (1996). For a detailed treatise of computational aspects see Salomon (2001). Articles written for the non-specialist include Daigle (1992) and Daigle (2000). The paper by Daigle (1995) focuses on the noise control aspects of sound outdoors. Finally, for the practical engineering aspects of predicting sound propagation outdoors see Piercy and Daigle (1991).

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