IMPROVING EXISTING PROPAGATION MODELS

Lidar and Sound Modelling

Simulation of sound propagation is key for todayâ€™s urbanised society, in which sound is omnipresent and often negatively affects peopleâ€™s lives. Existing methods of sound-propagation modelling fail to capture the complexity of terrain. Airborne Lidar in conjunction with aerial photos is able to fill this gap. The authors propose a programme of research to find out how high-resolution terrain data might improve the efficiency of sound models.

Sound propagation is affected by obstructing objects such as buildings and trees, and influenced by the relative location of sound source and receiver, type of intermediate ground and meteorological conditions. Computation of sound propagation requires positional information on source and receiver in relation to ground and obstructing objects. All paths from receiver to source to receiver need to be traced.

Lack of Detail
Accurate numerical techniques employ complex, computationally intensive methods to determine sound level at a certain point. Existing commercial models are based on semi-empirical techniques and fail to capture the complex arrangement of buildings and other objects. They thus use only approximate building and ground-type information, which unfortunately limits accuracy. Furthermore, the collection of high-resolution terrain data is cumbersome; it is currently extracted as approximate profiles from maps or contours, Digit–al Elevation Models (DEM) or through manual, point-by-point spreadsheet feeding along the section, which is laborious, time-consuming and often depends on survey quality. Recent models relieve the collection of terrain data, as they are interfaced with GIS. Once all the objects are provided with height, contours or DEM are generated automatically. Sectional profiles can then be determined and sound predicted. Sound-propagation software such as CadnaA and Lima offer multiple data-entering options such as ArcView, AtlasGIS, MapInfo, ASCII-Poly and DXF. The ability of these sound-modelling software packages to handle DEM is an advantage but poor resolution DEMs often fail to provide necessary detail and limit accuracy. Lidar (Light Detection and Ranging) can fill this gap; it provides comprehensive topographic information.

Lidar and Photos
We have just begun efforts to use Lidar data and aerial photographs over a test site on the IIT Kanpur campus. Ground and above-ground objects will be identified by classifying Lidar data into planar surfaces, clusters of points and ground. Planar surfaces are associated with obstructions such as buildings, and clusters of points with objects like trees. These need to be distinguished because they respond differently as regards sound waves. Their geometric characteristics can be accurately determined. By combining Lidar with aerial photographs, ground may be classified into different sound-propagation categories. This data also provides accurate estimates of the location of source and receiver. By multiple sectioning of terrain between source and receiver various sound tracks can then be identified. Thereafter, sound level at any point can be predicted using existing sound-propagation software. A sound propagation experiment is planned to validate the outcomes and corroborate the hypothesis that model performance will improve with higher resolution data. This experiment will include an omni-directional source.

Anticipated Results
High-resolution data may be used to test semi-empirical models for weaknesses. Similarly, various approaches for extracting information from Lidar data will be studied to find the best technique for incorporating terrain data. A GIS-based system can then be developed which will take Lidar data, aerial photographs, positional information for sound source and receiver, and meteoro–logical parameters to accurately compute sound level at any position. This can be used for noise mapping, soundscape application and sound-barrier design. It may also be extended to 3D realisation of sound.

Experimental set-up
Receivers will be positioned at differ-ent elevations to account for sound-level variations along elevation. Two locations (l1and l2) will be selected such that different terrain complex-ities and ground-type variations will be present between source and receiver. Different octave-band central frequencies will be used for the experiment, while the sound source will buzz in continuous mode and its intensity will be sufficiently high to reach the receiver and overcome background noise levels. Controlled experiment will be carried out under near-neutral meteorological conditions.