Technical Note

Note: Technical notes are aimed at promoting discussion. The views expressed are not necessarily those of the editors or the Australian Acoustical Society. Contributions are not formally peer-reviewed.

MODELLING SOUNDSCAPES

Rob Bullen
Wilkinson Murray, Crows Nest, Sydney NSW 2065

(This technical note is a summary of a presentation to the NSW branch of the Australian Acoustical Society earlier this year)

Most effort in architectural acoustics goes into spaces where acoustics is critical – concert halls, lecture theatres, places of worship, etc. This means that the vast majority of spaces, where most people spend most of their time – cafés, call centres, foyers, dance studios, courtyards etc. - have little or no serious thought given to how the space will sound.

Obviously the detailed acoustic modelling and assessment techniques used for a concert hall are inappropriate for a café. Acoustic design for such spaces needs to be a very quick and simple process. Preferably it should be done by an acoustic professional, but in cases where the project cannot afford that, approximate design by a non-professional (e.g. an architect) with some training may be better than nothing. What we need for these "also-ran" spaces is:

- a simple set of parameters that will encapsulate the important acoustic properties of ANY space; and
- a simple way to model the space, view the values of those parameters and listen to an approximate simulation of the sound.

As a set of parameters to describe the acoustic properties of a general space, I propose the following:

- background SPL (note "background" means "constant", not "quiet");
- sounds that should be inaudible (i.e. L_{Amax} < background -10dB), and sounds that should not be intrusive (i.e. L_{Amax} < background + 5 dB);
- reverberation time; and
- a measure of speech intelligibility (STI?).

These parameters provide a systematic way to summarise the acoustic design intent for the space, and can be used to guide the design process. The last is controversial – or at least there is dispute about the best units to use to describe speech intelligibility. Resolving this is regarded as an important priority. For example, for a café the design parameters might be:

- Background SPL = 45 dBA because we want a relatively quiet cafe. This can be partially from external traffic noise and partially from air-conditioning.
- Sound from the kitchen, and from the bus stop outside, should not be intrusive (therefore LAmax < 50 dBA). Sound from PA in the adjacent retail space should be inaudible (therefore LAmax < 35 dBA).
- Reverberation time 0.5 secs because this café is intended to be "calm", not "buzzy".
- Patrons' speech to be intelligible within 3m.

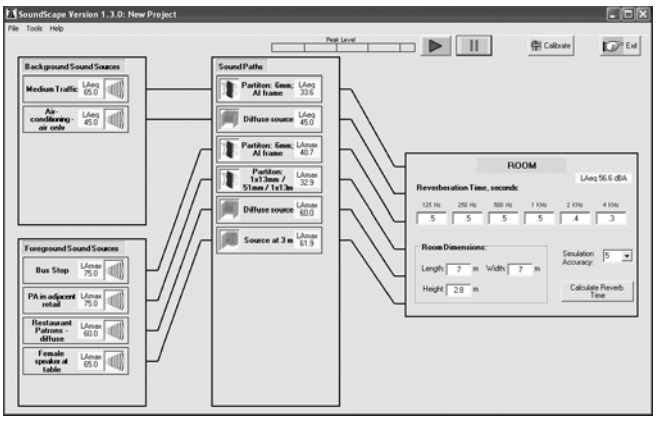
SoundScience has produced a program called SoundScape that is intended to fulfil the requirements for modelling of general acoustic spaces. The program allows you to:

- select sound samples from various background and foreground sounds (you can add more), and define their absolute level;
- place them either in the room at a distance, in the room as a diffuse source, or outside the room (in which case you select the construction for the partition);
- adjust the reverberation time; and
- listen to the result.

For the café example, you can select samples representing all the relevant sources, and enter them into a basic model (room size and shape defined only by length, width and height). You can play with, for example, the external glazing, to achieve the right internal level from a bus. You can design the reverberation time from material properties and areas (Sabine approximation). And finally you can push "Play" and listen to the room. A screen shot from such a model is below.

Other features include:

- good generic reverberation simulation, including direct sound, using stereo 25-delay feedback delay network with frequency-dependent reverberation time;
- ability to add new sound sources (as 16-bit WAV files), partition types and surface finishes; and
- ability to calibrate, so the simulation is reproduced at the correct SPL.



How can you get a copy of the SoundScape program? Just go to http://www.soundscience.com.au/products/soundscape.htm