3-D sound: massive *and* minute

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The technical, perceptual and aesthetic exploration of cellular "multi-scale" artificial auditory environments

Imagine…
Being able to listen to a recording of some remote, exotic, large-yet-detailed environment. Let's say: a Tunisian marketplace, with all the hustle-and-bustle, a myriad of tiny sound events that all go to form a whole, *large* place. As with fractal geometries, one can stand back and consider the whole pattern, or zoom in endlessly to explore finer and finer detail.

Imagine…
Being able to *compose*, *construct* and *control* such a finely detailed artificial environment.

In this modest ambition, the University of Derby is in the very front line of research and technological development. Real word environments *are* so infinitely explorable, and we have been pursuing the means to conjure such complexity artificially. Now, through the TQEF funding stream, our students can grapple with spatial audio technologies that will not reach most ears for a decade or more.

1. Stage One: Engineering

Managing large numbers of loudspeakers coherently relies on custom software and non-standard usages of pre-existing hardware. The previous work by Dr. Bruce Wiggins has been extended to accomplish this. We can currently deploy up to 40 speakers (more if cost constraints were removed!), covering a large listening area whilst retaining some control of very fine-grain spatial attributes. Final year students have experimented with various use-specific instantiations of this software. They have explored interface problems, perceptual effects and made forays into understanding aesthetics within this new approach. These experiments help to drive our development of control structures which are then handed back to the students for further rounds of 'destructive testing' this process will continue into the next academic year.

2. Stage Two: Perception

Conventional "living room" surround sound appeals to human spatial perception in very limited ways. Listeners must be seated in exactly the right position and orientation for the illusion of spatiality to work correctly. However, in this system as in the *real* world, listeners can move and *explore* the field. This exploration is a powerful perceptual tool.

Building on previous work by Dr. Peter Lennox, students will partake in tests whose outcomes will be used in delineating the "perceptual rules" of this new artificial environment. Preliminary work suggests that not all technical manipulations are equivalent in terms of perceptual effect, so results will be iteratively fed back to push technological development. Students are already enthusiastically devising their own experiments. Available time is the main constraint here!

3. Stage three: Aesthetics

We are all familiar with places that sound "nice", "interesting" or "relaxing". We also know of places that are unpleasant sounding, fatiguing or even "threatening". Students, through practical experimentation, will build on understanding of what these terms actually *mean* and how they can be parameterised for control purposes.

4. Ongoing

4.1. Custom spatial sound material

Commercial recordings for this kind of project do not exist, of course (since no such system has previously existed!). Using the research facilities of the Signal processing and Applications Research Group (SPARG), custom recordings of whole environments, part-environments and special features are being made. Some environments (for example the interior of the Derby Cathedral) are relatively large. Other items (a whispered conversation, a crisp-packet blowing in a breeze) are finely detailed and require different techniques. *Moving* items, thought to be particularly perceptually impressive, must be treated with care. Additionally, synthesised items that have never actually *existed* in the real world can be integrated into a complex, multi-scale artificial auditory environment. The creative possibilities remain to be explored.

4.2. Demonstrations

The initial trial demonstrations of the system and some custom recordings are, at the time of writing, scheduled to take place at the Final Year Degree Show at Kedleston Road on the 8th of June. The showing will be set up and run by final year students. Listeners will be able to walk toward, through and past a 'virtual choir' (courtesy of the *real* Derby Cathedral Choir) within the acoustic of the cathedral. There will also be a demonstration of "spatial DJ-ing" – a music form in its infancy – where some of the spatial control systems will be put to the test.

Other demonstrations are in planning stages. Several respected artists have expressed strong interest in composing with the system, which will drive exploration of the aesthetic issues.

5. Dissemination

In addition to this poster for presentation at the LTAARG conference in Buxton in July, a paper on the topic of navigable and explorable artificial sound fields is to be presented to the International Conference on Auditory Displays (ICAD 2007) in Montreal, Canada. The presentation will refer to student work with the system in relation to perceptual issues and findings.

A paper will also be submitted to the Audio Engineering Society (AES) for inclusion in a forthcoming international conference. Similarly, a report is to be submitted for presentation at a workshop of the EPSRC funded network spACE-Net, of which SPARG is a founding member.

Student independent studies dissertations based on use of the system (and of sufficient quality) will be considered for publishing on the SPARG website.