Creative Computing II

Audio Perception and Visualization

15th December 2010

This lab sheet involves generating sounds to illustrate particular aspects of audio perception, using *Processing* or *Octave* (or both). It also introduces the Sonic Visualizer software.

1. This part illustrates the phenomenon of *beats* being perceived from two superposed sinusoids at similar frequencies.

   (a) Generate and play, using either *Processing* or *Octave*, an audio signal of 5 seconds duration, consisting of the sum of two equal-amplitude sinusoids, one with frequency 440Hz and one with frequency 442Hz. Listen for beats; count the number of oscillations.

   (b) Repeat part 1a, with the second frequency being 441Hz; again, count the number of oscillations. Repeat once more, with the second frequency being 443Hz. What do you notice?

   (c) Repeat part 1a, with the first frequency being 220Hz and the second 222Hz.

   (d) Repeat part 1a once more, but generating a stereo signal, with one sinusoid in the left channel and the other in the right channel. Listen to the signal, both through a loudspeaker and (if possible) through headphones. What do you notice?

2. This part recreates a stimulus, illustrating grouping, due to Diana Deutsch.

   (a) Write functionality, in either *Octave* or *Processing*, enabling you to generate a sinusoid lasting for half a second at a frequency a given number of semitones above the A below middle C (at 220Hz). Check that notes 12 semitones apart sound 'the same', in the sense of being separated by a musical octave.

   (b) Adapt your work from part 2a to allow you to play multiple sinusoids, one after the other, in each audio channel.

   (c) In one of the two stereo audio channels, play sinusoids in sequence respectively {13,3,10,6,6,10,3,13} semitones above the A below middle C. In the other, play {1,12,5,8,8,5,12,1} semitones above (at the same time). Listen to your stimulus, both through a speaker and (if possible) through headphones. What do you notice?

3. This part is about visualising audio using Sonic Visualiser, a for powerful and highly-customisable visualization and annotation of digital audio.

   - The Sonic Visualiser application is installed on the Windows lab machines: a double click should start up the User Interface
   - Use the Import Audio File... entry in the File menu to import an audio file. Experiment with playing it back, and with the various UI controls to see what they do.

- In order to visualize things other than the audio waveform, some plugins need to be installed; this can be done as an unprivileged user, but only by setting a Windows Environment Variable, `VAMP_PATH`, to point to a directory that you can write to, for example `G:\vamp\`. Set this environment variable, and also download the Queen Mary plugin set from the VAMP plugins home page, saving the plugins to that directory.
- Restart Sonic Visualiser, reimport an audio file, and then experiment with the transforms in the Transform menu.

Other resources:

- The WAV file format. In *"Multimedia Programming Interface and Data Specifications 1.0*, Chapter 3; available at `http://www.tactilemedia.com/info/MCI_Control_Info.html`
- Sonic Visualiser home page: `http://www.sonicvisualiser.org`
- VAMP plugins: `http://www.vamp-plugins.org/`