Homework #2: Laboratory Exercise 1
Due Date: April 20, 2006

Laboratory Exercise 1: Dynamic Range Control

Problem 1. [50 Points]

Completion of the following exercises entails making modifications to the compressor plugin 'Compressor', for which source code can be downloaded from the class website, http://ccrma.stanford.edu/courses/424/spring-2005/handouts-2005.html. All necessary materials are contained in the file lab1.tar.gz.

Solutions for each exercise should include the source files Compressor.cpp and Compressor.hpp, suitably modified. The files must be able to be compiled. Additional write-up is required for some sections of this problem.

1(a). [10 Points] The stock compressor plugin uses a peak detector. Modify the code to use RMS detection. You will need to remove the controls for attack and release times, and add a control for the RMS integration time.

1(b). [10 Points] Edit the peak-detection code in the stock plugin so that the detector uses release-to-threshold, rather than release-to-zero. With the compression ratio set to infinity, the threshold of compression set at $-20\text{dB}$, and the input and output gains set to unity, write an expression for the compressor gain $\Phi_F(t), t > 0$, for the input signal $x(t) = 1 - u(t)$, using the stock detector. Repeat for the release-to-threshold detector.

1(c). [10 Points] Modify the stock compressor so that the release becomes program-dependent. Make the release behavior such that the release time is approximately one second following a sustained high input level, and make the release time following transients controllable using the existing slider for release time. Turn in plots showing the compressor’s response to the signal tdiff.wav, with the fast release component set to 100mS.

1(d). [10 Points] Add a soft knee to the compressor’s static compression function. Add a control so that the width of the soft knee can be set between zero and twenty dB.

1(e). [10 Points] Convert the compressor into a noise gate. Use the existing ratio control to control the plugin’s downwards expansion ratio.
Problem 2.  [40 Points]

For this problem, you will be asked to analyze the mystery plugin DRC.dll, which is contained in the file lab1.tar.gz. You may create any test signals you need to analyze the plugin, and may use MATLAB to study the output of the plugin.


2(b).  [10 Points]  Write pseudo-code for the static gain functions $\Phi_F$ and $\Phi_B$ that would be needed to implement this compressor using feedforward or feedback topologies.

2(c).  [6 Points]  Determine whether the plugin uses RMS or peak detection.

2(d).  [6 Points]  Determine the approximate attack and release times for this plugin.

2(e).  [14 Points]  Write pseudo-code for the signal estimator that would be necessary to implement this plugin for the feedforward case (7 Points) and the feedback case (7 Points).

*Hint: Unlike many audio-processing devices, the mystery plugin DRC will support the entire spectral band from DC to the Nyquist limit.*