Keystrokes, Animation, and Audio
Demo 61

DSP Lab (ECE 4163 / ECE 6183)

2024

Exercise

1. Modify the program `prog_03_diffeq.py` to also adjust the time constant and frequency of notes using keystrokes. The signal waveform should be displayed in the figure window as it plays.

2. Write a program that plays different notes for different keys on the keyboard. The program can be based on `prog_03_diffeq.py`, but instead of just a single note, it should enable a whole octave of notes (12 notes).

   The generated signal waveform should be displayed in real-time in the figure window as it plays. An example screen recording is provided:
   `keyboard exercises example screen recording.mp4`

   The notes should play over-lappingly (if a note is played before the previous notes have become silent, then both notes should be heard at the same time). The user should be able to play chords.

   For a full octave (twelve notes), adjacent notes on a piano keyboard are related via

   $$f_k = 2^{k/12} f_0, \qquad k = 0, 1, 2, \ldots$$

   You can set $f_0 = 440$ Hz which is middle A.

   To implement this, there should be a difference equation (filter) to implement each note. Each difference equation should have its own input and output signal. The output signals of the separate filters should be added together to give the total output signal. The total output signal should be written to the output audio device (loudspeaker/headphones).