Real Time Audio I/O Unit

This unit gets audio data from microphone. When the amount of data reaches the size of the block, it stores it into the shared memory. It also can play back the sound by reading the shared memory or directly transfer from input data.

Reason to choose Portaudio:

- It’s across platform, can be used in all operating systems.
- We can apply sample by sample processing, which can give us a really short delay.

PortAudio

Parameters:
- Block Size: 1024
- FS: frequency: 44100Hz

Data Processing Unit

This part is the core algorithm part, which detects the vibrato in music. The algorithm mainly detects AM and FM in music. The main process includes several steps:
1. Gets one block of data from the shared memory.
2. Filtering and smoothing.
3. Apply FFT to get frequency domain information.
4. Do the time frequency analysis to calculate the AM and FM information.

Time frequency analysis to calculate the AM, FM

In frequency domain, for each block of data, treat it like one time frame data after STFT. Then do peak picking, store the amplitude of the first reasonable peak as fundamental peak. Also store this frame’s phase data. When next frame comes, calculate the unwrapped phase difference then divided by time to get the instantaneous frequency, which is FM we need to detect.

Some other methods:

- Parabola fitting: May not be accurate enough
- YIN: Very accurate but slow, not a good choice for real-time analysis

Real Time Music Vibrato Visualization

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Graphic Visualization Unit

Using OpenGL, the graphic rendering can be very fancy. Currently it just shows us a spectrum. The spectrum can spin, it’s also easy to make it 3D version.

Why OpenGL:

- To serve the future goal, making it more like a game.
- Plus OpenGL is cross-platform.

Future Work

1. Implement vibrato detecting in C
2. Better visualization, more like a game
3. Testing with real vibrato sound
4. Robustness

Parameters:
- Block Size: 1024
- FS: frequency: 44100Hz

Audio Info data, converted to OpenGL rendering data

Shared Memory to store data from microphone

Data after processing mainly contain AM, FM

FM vs Time

AM vs Time

FFT

Data Processing Unit

Real Time Audio I/O Unit

PortAudio

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