## *Task Done*

- Tweak settings of the Moorer's reverb generator to achieve different effects
- Gave presentation to the rest of the company on how these effects were achieved

### Recap

Reverberation is achieved through a Moorer's reverb generator using comb/low-pass filters and all-pass filters in combination with the original anechoic sound effect. The diagram shows the 4 comb 2 all-pass version. However, the one that I chose to use was the 6 comb 1 all-pass version that Moorer eventually used to simulate a concert hall's settings.

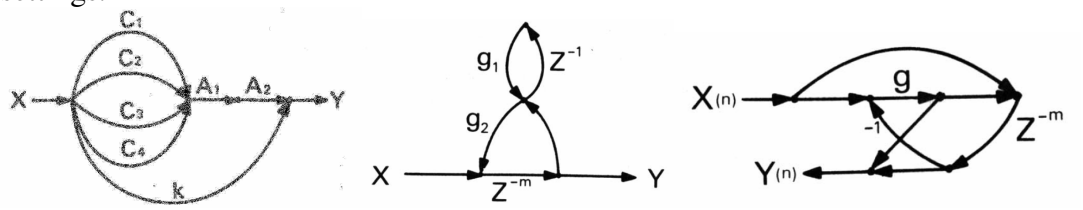


*Figure 1 – Moorer's reverberator (left) with its component of a low-passed comb filter (centre) and all-pass filter (right).*

Included with this document should be the sound effect files with the different settings applied to them. Two sound effects were chosen to show the characteristics of each setting. A speech file would allow us to better hear the overall effect of the reverb due to the gap between each syllable spoken. An impulse sound will allow us to hear the impulse response of the filter. For this, a sharp crow cry was chosen. Then, just for fun, I added in a piece of music which has been altered using the reverberator, with the settings tweaked such that it seems as if the band is playing in a stadium.

### Settings tried

- Moorer's Settings
  - This is the original Moorer settings, included here as a form of comparison to the other settings
- Low g (Big Cave) Settings
  - For this setting, I reduced the g component of the low-passed comb filter
  - This, in effect, reduces the attenuation factor for each pass into the comb filter.
  - Thus, a long reverb tail is produced, achieving a reverb effect similar to if the sound was played in a big stone cave
- High g (Heavy Attenuation) Settings
  - This setting is the inverse of the Low g setting
  - This produces a reverb effect similar to a heavily carpeted and curtained room that absorbs sound well but still has minimal reverb
- Less dry (Far away) Settings

- For this setting, I adjusted the k component of the Moorer's reverberator such that less of the original sound is in the final output.
- This produces an effect similar to if the sound was played at the end of a long tunnel

These are the basic effects that reverberation is able to produce. In general, these effects affect the listener's spatial perception of the room (distance of sound source) as well as his/her perception of the characteristic of the room (sound attenuation capabilities of the room). With a combination of the above settings, many different reverberation settings can be achieved. As a demonstration, I used a combination of the settings above to alter a piece of background music I found in the data directory of the Baja game. The end result is an effect of the band playing in a reverberant stadium. To more clearly hear this effect, listen to the differences in the guitar part at 0:31 between the original recording and the reverberant recording.

## *Task Done*

- Search for more contemporary algorithms
- Study differences between these and Moorer's work
- Implement these algorithms

### Research

After much reading, I realize that many of the later works in the field of reverberation draws their inspiration from Moorer's work. In particular, the work of John Stautner and Miller Puckette which was later modified by Jean-Marc Jot stands out. In the paper "Digital Delay Networks for Designing Artificial Reverberators", Jot describes how he broke down the characteristics of the parallel comb filters used by Moorer to achieve what he calls a Feedback Delay Network (FDN).

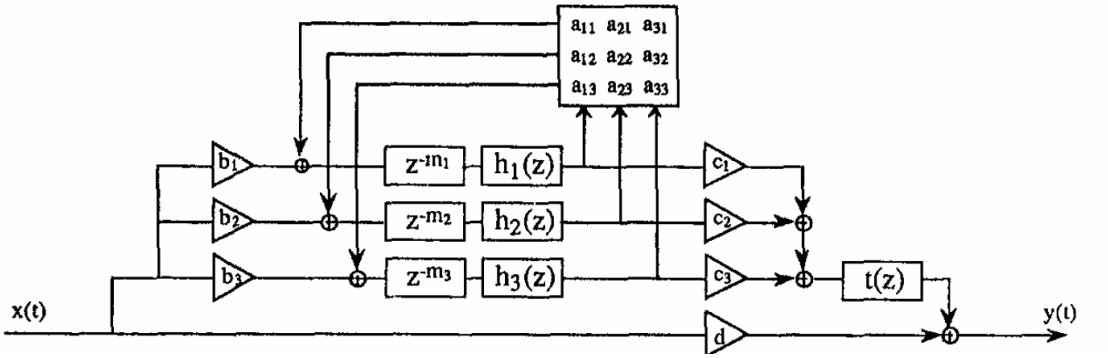


*Figure 2 –Feedback Delay Network including absorbent filters h(z) and tone corrector t(z)*

As can be seen from the diagram, this method greatly simplifies the process of reverberation. In essence, the algorithm only has one simple loop with the sound effect being modified by the matrix during each pass. The advantage of this is obvious. Real-time effects can be much better created using this algorithm as each pass through it produces a sample that can be immediately streamed, thus enhancing the speed of the reverberant effect. This algorithm was implemented with the default settings used.

### Problems Faced

Jot claims that Moorer's effect as well as many other effects can be recreated using this algorithm. However, the mathematical explanation defies my limited understanding of complex numbers. Even after reading the paper a few times, I am unsure as to how he managed to arrive at the coefficients in the matrix. Thus, because of this, I am unsure as to how to change the settings in the matrix to match settings changed in the Moorer's algorithm, which is a lot more intuitive.

## *Task to be done*

- Try and understand Jot's papers and the related papers that he and others wrote regarding FDN
- Through this, try and tweak his settings to achieve different effects
- Start research into methods to efficiently simulate the early reflection portion of artificial reverb
- Implement one of these methods if time permits