SIMULATING A REVERBERATION EFFECT USING CONVOLUTION IN MATLAB

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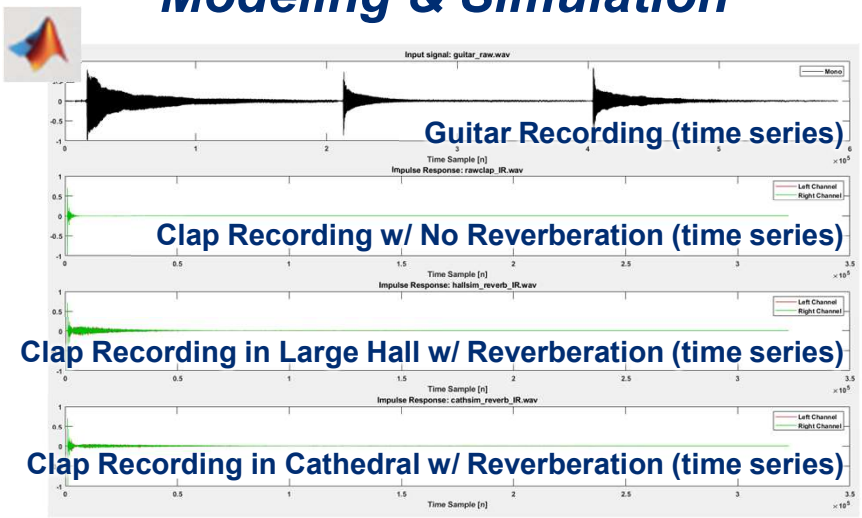
Motivation

- The convolution operation expresses how one function is modified by another through folding, shifting, multiplying, and summing
  - Defined as the integral of the product of two functions in which one function is flipped and shifted
  - Fundamental to studying linear time-invariant systems and applications of the Fourier transform
- Nearly all engineering textbooks introduce the concept of convolution from an algorithmic perspective
  - Often a 4 step process: Fold, Shift, Multiply, Sum
- To supplement one's understanding of convolution, in addition to providing a practical application not mentioned in elementary textbooks, this MATLAB demonstration provides a step-by-step approach to apply convolution where one can hear their results

Modeling & Simulation



Technical Approach

Record Sound Files

$x[n], h[n]$ → Both in .wav file format

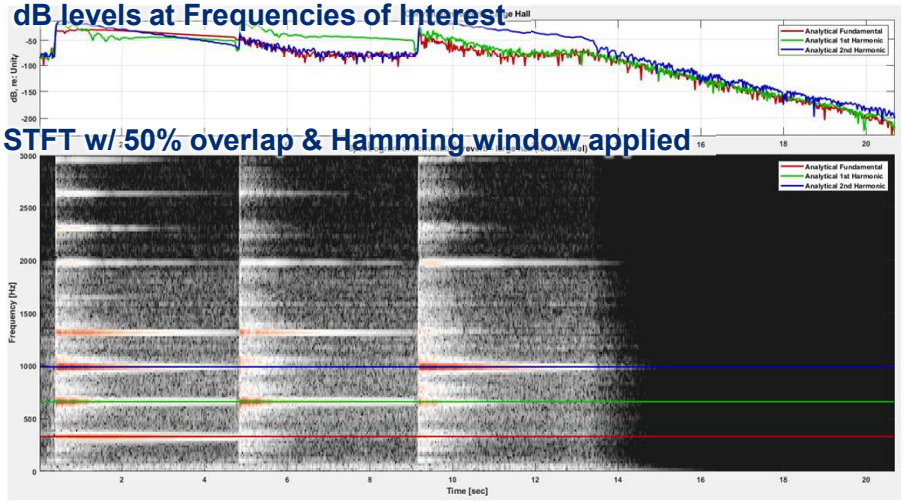
Perform Convolution

$$(x * h)[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

Perform STFT

$$X(m,\omega) = \sum_{n=-\infty}^{\infty} x[n]w[n-m]\exp(-j\omega n)$$

Results



- Convolution reverb demonstration was successful using an at-home sound recording of guitar bridge harmonics, simulated impulse responses, and the short time Fourier transform
- Harmonic content of guitar string still present after convolution at the expense of a longer convolved signal featuring an increased noise floor