Complex Waveforms: Phase and Delay

Complex Waveform

- Any waveform which is not a sine wave.
- Will be comprised of two or more sine wave elements

Fourier Analysis

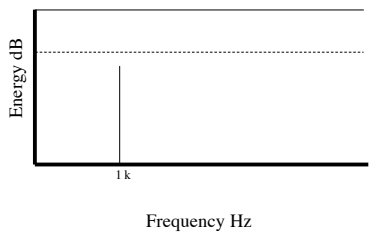
- Any periodic complex wave can be reduced to a sum of sine waves of different frequencies, amplitudes, and phases.
- This is also the way that the human ear responds to complex sounds.

How do Sounds combine?

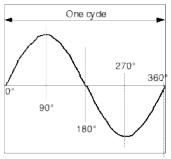
By performing instantaneous addition of relative pressure

New type of chart

Frequency/Energy Chart

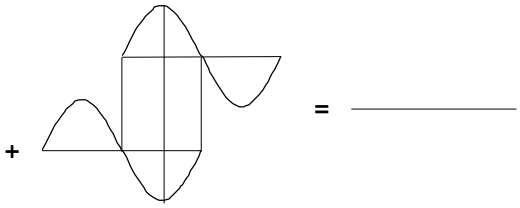


Phase

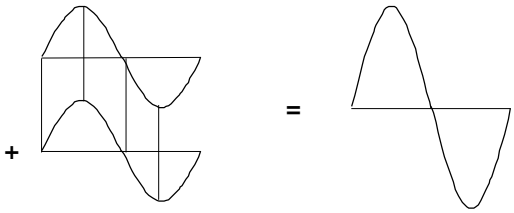


- Otherwise identical waveforms can experience phase issues
- Out of phase
- In phase
- These issues can be very tricky

Phase Cancellation

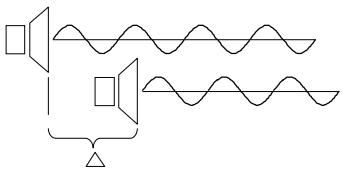


Phase Augmentation



Delay Issues

- Different frequencies and distances will have different phase issues



Calculating cancellation properties from speed of sound and frequency

Beats

- From slightly different frequencies

The Octave (review)

- Doubling of frequency
- How many octaves in the human range of perception?

Harmonic Series

- Whole Number Multiples of fundamental frequency
- Any resonating system exhibits these properties