3.8.1.2: Sound Waveforms Simulation

This simulation explores the aural texture of four basic periodic waveforms: sine, triangle, square, and sawtooth. The sine waveform has a single frequency and is the building block of other periodic waves by summing harmonics in a Fourier Series as we will see in the next section. The richness of the sound is called the timbre (defined in the previous chapter) and is determined by the amplitude of the harmonics in the Fourier sum.

Click on the waveform image to hear the difference types of sounds these waveforms produce and drag up and down within the image to change the waveform frequency. Drag left and right to adjust the volume. The sine waveform produces the smoothest sound because it consists of a single fundamental frequency F_o. The triangle waveform has a richer and higher timbre because the dominant frequency F_o is joined by the odd harmonics $3F_o, 5F_o, 7F_o$, etc. The square waveform also has only odd harmonics but it sounds higher than the triangle waveform because the amplitude of these harmonics is greater than for a triangle waveform. In other words, the triangle waveform more closely matches a sine waveform than the square waveform. The sawtooth waveform has the most complex timbre because every harmonic is present.

The Sound Waveforms JavaScript Model uses the HTML 5 Web Audio API. This API is still under development and may not be supported on all platforms. Press the Reset button to reinitialize the simulation if the sound does not play when the simulations is first loaded.

Note

Press Reset if sound does not play when the simulation first loads.

Simulation Questions:

When two waves have the same fundamental frequency they have the same pitch, according to our ears. If there are other frequencies present (overtones) the pitch stays the same but the timbre is different. Note: Computer speakers do not play very low or very high frequencies accurately; this simulation works better if you use better speakers or headphones.

1. Listen to each wave by clicking on the appropriate picture without changing the fundamental frequency. Describe how each one sounds (what is the timbre of the sound for each one?).
2. Can you distinguish each waveform from the others even when the fundamental frequency is the same?
3. Now drag the mouse cursor up and down on one picture to change the fundamental frequency (or change the number in the box). What do the other waves sound like at this frequency? Is the pitch the same? Can you still tell them apart?