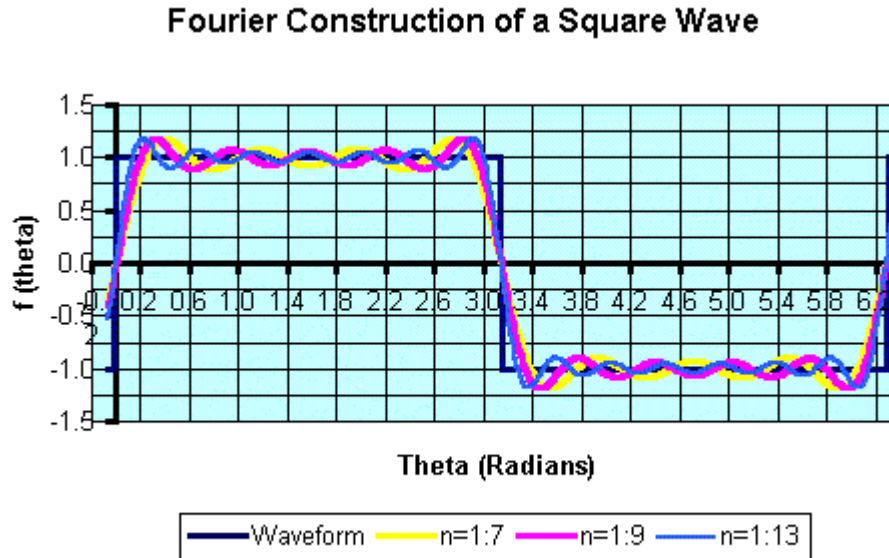


The second figure shows the bipolar square wave (labelled as “Waveform”) overlaid with three other waveforms: that associated with the fundamental through the 7th harmonic (“ $n = 1:7$ ”), then the waveform associated with fundamental through the 9th harmonic (“ $n = 1:9$ ”), then the waveform associated with fundamental through the 13th harmonic (“ $n = 1:13$ ”).



As each of the higher harmonic terms is added in, “building” the Fourier series for the bipolar square wave, the agreement between each successive waveform and that of the actual bipolar square wave becomes better and better. As stated earlier, the higher harmonic terms are required to achieve good agreement in the most rapidly-changing portions of this waveform, as can be seen from these two figures.

In rock music, the square wave shows up on the output side of various kinds of “fuzz” (i.e. distortion) effect (FX) “stomp” boxes used for altering the signal(s) from electric guitars, most notably used e.g. by heavy-metal bands. In many of these type of distortion FX boxes, the signal gain is very high. Somewhere in the FX box circuit, a non-linear circuit element, such as a pair of back-to-back diodes “clips” the large-amplitude signal from the guitar, chopping off (i.e. limiting) the peaks, thus creating a square wave-type signal. Note also that the FX box *also* additionally acts as a *signal compressor/limiter*, as a consequence of clipping the large-amplitude input waveform. Another interesting aspect of the use of distortion FX boxes is that the resulting high-harmonic content sound wave output from the guitar amplifier can acoustically couple back to the strings of the electric guitar, providing the necessary energy to drive the strings into so-called “infinite-sustain”, also known as feedback. This acoustical feedback coupling is (usually) *not* via the fundamental; it occurs *primarily* through the acoustical feedback coupling associated with the 3rd harmonic of the square wave!

Square waves also have use(s) in electronic keyboard-type instruments, as part of a large “palette” of keyboard sounds.