Note that the first four harmonics - the fundamental (aka first harmonic), the second, third and fourth (even though it has zero strength) harmonics all have the same phase angle, $\delta_n = +180^o$. The next four harmonics have the opposite phase angle, $\delta_n = -180^o$, the next four after that are in phase again with the first four harmonics, and so on. This behavior of the groups-of-four phase angle arises from the *sin* ($n\pi/4$) term in the Fourier coefficients, b_n for the sawtooth waveform.

The *sound* of an audio sawtooth wave to the human ear is *brighter* than the triangle wave, due to the existence of the *second* harmonic in the sawtooth wave, which is *absent* in the triangle wave. If the loudness of the fundamental, $L_1 = 60\ dB$ ($100\ dB$), then the loudness of the second harmonic is $L_2 = 50.9\ dB$ ($91.0\ dB$), corresponding to a loudness ratio of $L_2 / L_1 =$ 84.9% (91.0%), respectively. For the third harmonic associated with the sawtooth wave, $L_3 = 40.9\ dB$ ($80.9\ dB$), corresponding to a loudness ratio of $L_3 / L_1 =$ 68.2% (80.9%), respectively. Interestingly enough, these loudness results for the third harmonic of the sawtooth wave are also *precisely* those for the triangle wave, as are all the odd-*n* loudness results! The sawtooth wave differs from the triangle wave primarily because of the additional presence of the even-*n* harmonics, however note also that the *phase relations* for the odd-*n* harmonics are *not* the same for these two waves. As we have mentioned before, the human ear is *not* sensitive to such phase relations.

The following figure shows the loudness ratios, L_n / L_1 for the first twenty harmonics (i.e. $n < 20$) associated with the bipolar sawtooth wave, for loudness values of the fundamental of $L_1 = 60\ dB$ (~ quiet) and for $L_1 = 100\ dB$ (~ quite loud). This is what the human ear perceives as the loudness of the harmonics relative to that of the fundamental. Note that the decrease in the loudness ratio, L_n / L_1 with increasing harmonic #, n is again rather slow.