TANH FUNCTION SINE SHAPER--SEAT OF THE PANTS VERSION

Phil Hobbs

ElectroOptical Innovations
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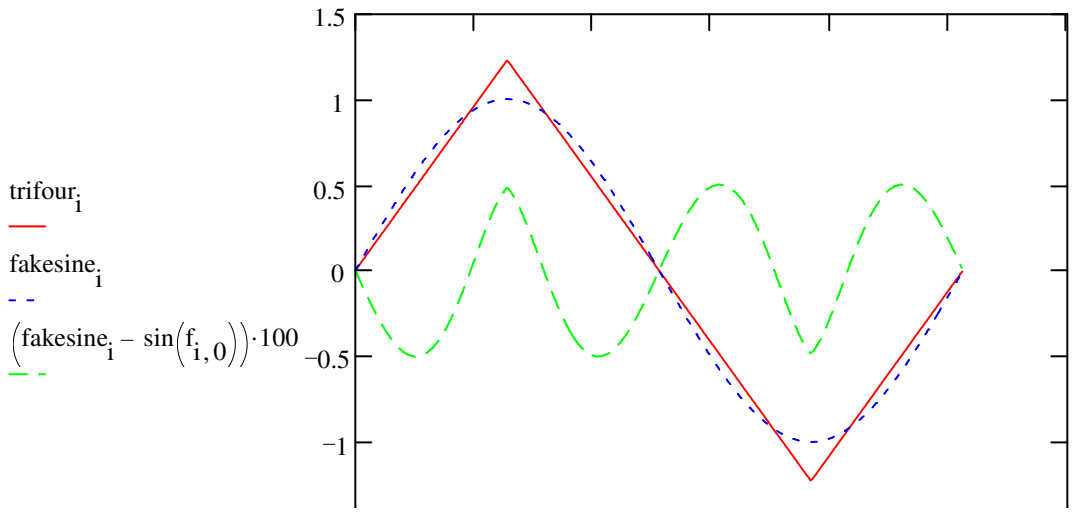
The strategy here is to generate a tri wave, then bung it into a BJT diff pair to curve it over a bit, and subtract a bit of the original tri wave to get rid of the cusps. To realy optimize this you want to compute the THD as a function of the amplitude going into the tanh shaper and the amount of tri wave subtracted, but that's too much like work for a sci.electronics.design post!

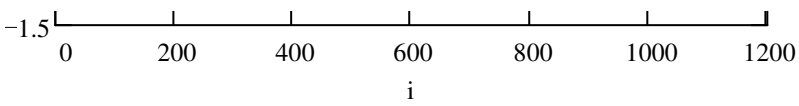
$imax := 1023 \qquad i := 0 .. imax$

$nmax := 100 \qquad n := 0 .. nmax \qquad f_{i,n} := 2\cdot\pi\cdot\frac{i}{imax+1}\cdot(2\cdot n+1)$

$$trifour_i := \sum_n \frac{(-1)^n\cdot\sin\left(f_{i,n}\right)}{(2\cdot n+1)^2}$$

$$fakesine_i := \left(\tanh\left(0.4\cdot trifour_i\right) - 0.316\cdot trifour_i\right)\cdot 14.97$$





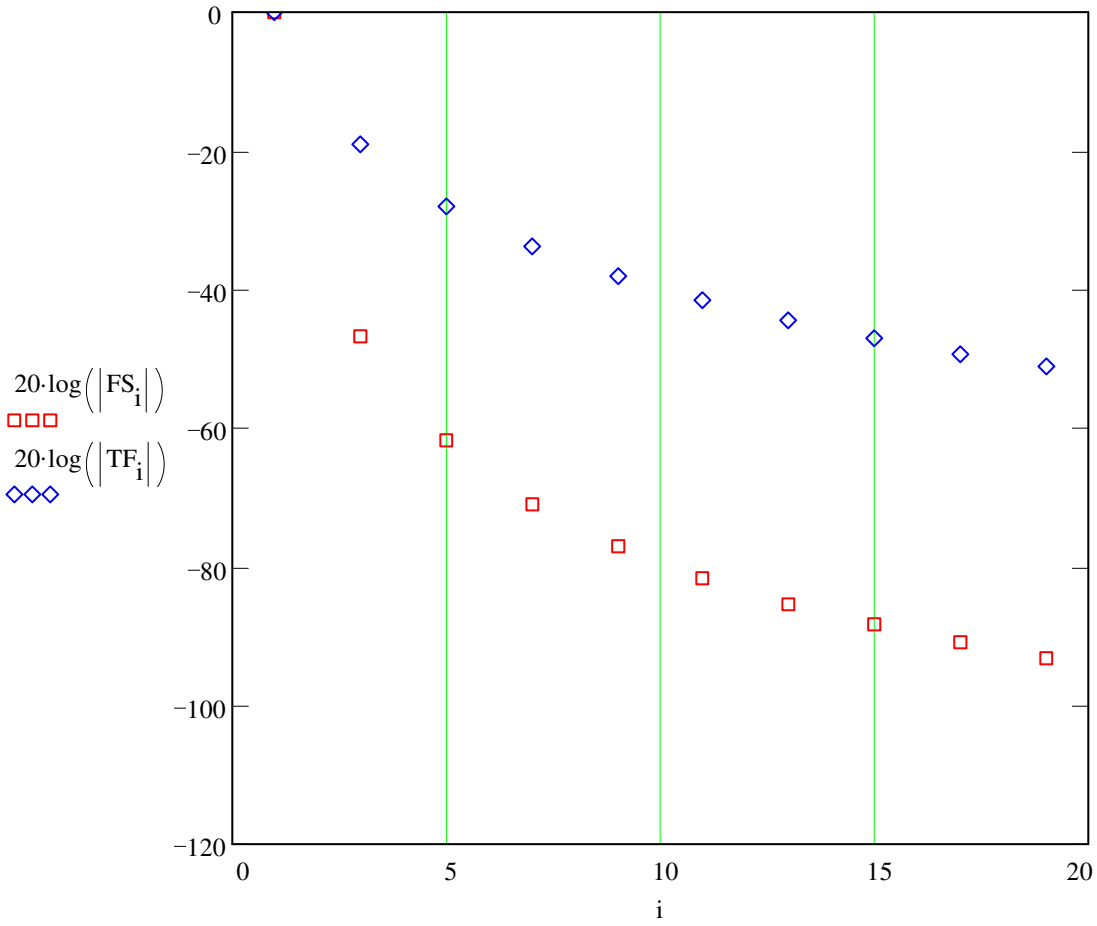
$$\sqrt{\frac{\sum_i \left(\text{fakesine}_i - \sin\left(f_{i,0}\right)\right)^2}{\sum_i \sin\left(f_{i,0}\right)^2}} = 0.0049039$$

$$\text{norm} := \sqrt{\frac{4}{1024}}$$

$$FS := \text{cfft}(\text{fakesine}) \cdot \text{norm}$$

$$TF := \text{cfft}(\text{trifour}) \cdot \text{norm}$$

$$\max(FS) = 0.999i$$



The tanh shaper (even in this poorly optimized version) gives about 0.5% THD, predominantly third harmonic. Higher harmonics go away nearly completely due to cancelling the cusp.