Some Properties of a "GGMS" Fifth Generation of Split Magic Sinewaves

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Magic Sinewaves are a newly discovered class of mathematical functions that hold significant potential to dramatically improve the efficiency and power quality of solar energy synchronous inverters, electric hybrid automobiles, and industrial motor controls, among many others. An executive summary can be found **here**, a slideshow type intro presentation **here**, a development proposal **here**, the latest calculator **here** with its tutorial **here**, demo chips **here**, and more info **here**.

Major goals of such digital sinewave generation including offering the **maximum possible efficiency** by using the fewest of simplest possible switching transitions; offering the **lowest possible distortion** by zeroing out a maximum number of low harmonics that impact power quality, whine, vibration, and circulating currents; and by using **all digital techniques** that are extremely low end micro friendly.

Magic sinewaves have two remarkable properties: **Any number of desired low harmonics can be forced exactly to zero** in theory, and to astonishingly low levels when quantized to 8-bit compatible levels. And magic sinewaves use the **absolute minimum possible and simplest energy-robbing transitions** to achieve such harmonic suppression.

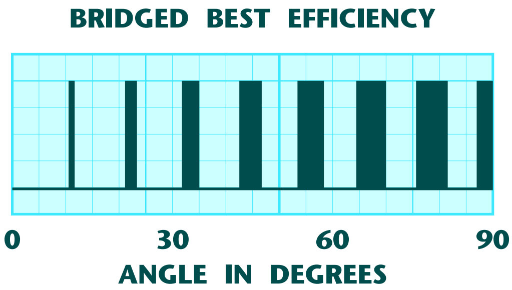
Too Good to be True?

The latest evolving version of magic sinewaves may in fact turn out too good to be true. We seem to have stepped well beyond the "Freeze Dried Holy Grail in a Spray Can" stage. But may have raised a realizibility issue or two.

Because of this, **what is presented here is done so spectaculatively for your critical comment**.

The latest versions combine **two** complementary types of magic sinewaves used sequentially once per quadrant. Resulting in a highly significant reduction in any remaining uncontrolled harmonics and dramatically reduced filtering needs. And virtually all of the Magic Sinewave energy being focused on the fundamental.

Consider this traditional first quadrant **Bridged Best Efficiency** Magic Sinewave of eight pulses per quadrant...



This is a nice workhorse magic sinewave we looked at a number of times before. You can thoroughly study it with this **high speed calculator**.

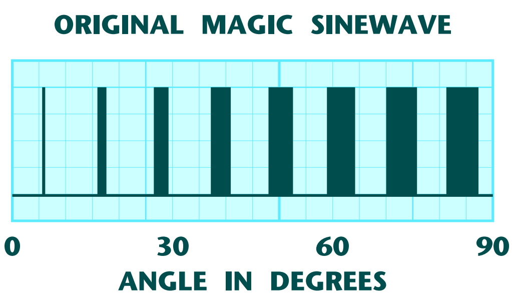
This particular choice generates a fundamental amplitude of **0.53** and zeros out its first **thirty** harmonics. And does so using an absolute minimum of efficiency robbing switching transitions. Ridiculously fewer than traditional PWM, besides being single ended.

This earlier magic sinewave had a flaw that created filter and harmonic energy issues. While all of the first thirty **controlled** harmonics are forced to precisely zero, the next four **uncontrolled** higher harmonics were usually of fairly significantly amplitude and raised filtering questions.

Specifically, the prefiltered amplitudess of the first four uncontrolled harmonics were **h31 = -0.778855482**, **h33 = 0.5788665**, **h35 = 0.1799184**, and finally **h37 = 0.01901977**.

These were amplitude dependent and may range from one fifth the fundamental at near unity amplitude to pretty much matching the fundamental size at low output amplitudes. Unlike PWM, the harmonics **never** significantly exceed the fundamental.

Let’s next consider an original **n=8** Magic Sinewave that was something of an abandoned orphan left over from way on back in our Calculator II days...



This original Magic Sinewave stunningly "interleaves" the Bridged Best Efficiency one we just looked at. It also generates 0.53 amplitude and also zeros out the first thirty harmonics.

Curiously, this magic sinewave uses its first four uncontrolled subharmonics in an **almost opposite** manner than the bridged best efficiency one! So this time, the prefiltered amplitudes of the first four uncontrolled harmonics will be **h31 = 0.7644320630**, **h33 = -0.5967264126**, **h35 = -0.183395826**, and finally **h37 = -0.018748667**.

So, if we use a Bridged Best Efficiency magic sinewave for our first quadrant and a regular Magic Sinewave for our second, our h31 first unwanted subcarriers should "average out" for significant suppression. Perhaps **-0.0144** instead of **-0.7788** or **0.7644**. And that is **before** filtering.

The amount of by-quadrant unwanted carrier rejection can become stunningly impressive for very low amplitude values. Hence the concern for its validity.

Summarizing the GGMS Method

Here's a wrapup of how to use this new GGMS magic sinewave method...

To use the GGMS Magic sinewave method...

(1) Build one quadrant using original magic sinewaves.

(2) Build the next quadrant using Bridged Best Efficiency.

(3) Rinse, lather, and repeat.

Details will depend upon the ap. In general, low amplitudes will provide nearly complete unwanted harmonic suppression, while larger ones may need additional treatment. Some post filtterng needs will likely remain. File and program sizes may also have to be increased somewhat for these dual quadrant schemes.

While there **should** be no difference between quadrant cancellations and, say, the seventh harmonic getting around to forcing its zero near cycle end, please report any possible problems with the above analysis. Which, at present is completing some early low level synthesis modeling.

For More Help

Further **Magic Sinewave** explorations require your participation as a Synergetics **partner** or **associate**.

To proceed, view the many **Magic Sinewave** tutorial files and JavaScript calculators you'll find at **http://www.tinaja.com/magsn01.asp**.

Full **consulting services**, custom designs, **seminars**, and workshops are available. Or you can email **don@tinaja.com**. Or call **(928) 428-4073**.

Oh yeah. **GGMS** is short for "**Golly Gee, Mister Science**".