

What prompted me to dialogue ChatGPT on Parametric Pumping was another dialogue I had with Google's AI on my use of Golden Ratio Parameters which might spawn a Variable Mutual Inductance.



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[Here's a share link to that dialogue.](#)

And here's the post which that dialogue spawned:

Parametric Mutual Inductance is Potentially One Example of a Counter-Spatial Source for Energy Exhibiting non-Euclidean Geometry

VINYASI • 12:44 AM

A conversation with ChatGPT — share link.

[Read full story](#)

What I was seeking was confirmation that my Golden Ratio circuits do not violate anything. Instead, they validate parametric pumping via a

variable mutual inductance field-effect surrounding what are otherwise passive (non-varying) components.

Here's a copy of that dialogue:

Me:

Can the golden ratio mimic parametric mutual inductance if it should become involved with mutual inductance in its static format? Can it alter it to become parametric?

Google's AI:

No, the golden ratio ($\phi \approx 1.618$) cannot inherently alter static mutual inductance to become parametric, nor can a static number alone mimic a time-varying or state-dependent physical parameter.

To transform a static mutual inductance system into a parametric one, you must introduce an active structural change or an external energy injection. However, the golden ratio can be explicitly used as a *geometric or mathematical blueprint* to design and optimize parametric systems.

1. The Core Distinction

- **Static Mutual Inductance (M):** This occurs when two coils have a constant geometric arrangement and a constant core permeability (μ). The mutual inductance is a fixed value governed by Neumann's formula: [1, 2, 3]

$$M = \frac{\mu_0 \mu_r}{4\pi} \oint_1 \oint_2 \frac{d\vec{l}_1 \cdot d\vec{l}_2}{r_{12}}$$

- **Parametric Mutual Inductance ($M(t)$ or $M(x)$):** This requires the mutual inductance parameter to vary actively over time or as a function of an external state (such as physical displacement, mechanical rotation, or nonlinear core saturation).

A pure mathematical constant ϕ applied to a static system yields only another static value.

2. How the Golden Ratio Can “Mimic” or Guide Parametric Behavior

While the golden ratio cannot spontaneously induce parametric changes, engineers use it to deliberately structure systems that exhibit specialized parametric behavior:

A. Geometric Tuning for Anti-Misalignment

In wireless power transfer (WPT) systems, physical movement (displacement x) usually causes mutual inductance to drop sharply. By arranging multi-coil arrays or spiral windings according to Fibonacci sequences or golden ratio aspect ratios, designers can create an optimized coupling profile. As the system undergoes physical displacement, the interaction of the fields mimics a smoothly regulated, constant parametric inductance loop over a wide range of movement. [1, 2]

B. Parametric Amplification via Nonlinear Cores

To convert a static format into a parametric format, you must modulate the core's permeability (μ). If you construct an inductor matrix using the golden ratio for the turn ratios ($N_2/N_1 = \phi$) and wrap them around a nonlinear ferromagnetic core, pumping a strong biasing current (I_{pump}) into the primary coil will alter the core saturation. Because (μ) changes with the pump signal, the static mutual inductance becomes a time-varying parametric function:

$$M(t) \propto \mu(I_{\text{pump}}(t))$$

The golden ratio spacing ensures that the resulting parametric harmonics and frequency-splitting profiles are distributed non-periodically, preventing unwanted sub-harmonic resonances. [1, 2]

Summary Matrix

System Setup	Nature of Mutual Inductance	Role of the Golden Ratio (ϕ)
Purely Static Coils	Static ($M = \text{constant}$)	Defines fixed spatial geometry or turn ratios; cannot force parametric behavior.
Moving/Rotating Coils	Parametric ($M(t)$ via motion)	Smooths out the coupling profile to create uniform power transfer zones.
Nonlinear Saturable Cores	Parametric ($M(t)$ via electrical pumping)	Optimizes step-up distribution and dampens destructive resonant peaks.

✔ Conclusion

The golden ratio **cannot spontaneously alter a static system into a parametric one** because it is a constant, not a dynamic driver. To make a static mutual inductance system parametric, you must physically move the coils or electrically modulate the core material. The golden ratio can, however, be used as a design blueprint to control and optimize how those parametric changes behave.

If you are developing a specific circuit, are you looking to design a **mechanically driven parametric variometer**, or an **electrically pumped parametric amplifier** using nonlinear magnetic materials?

Me:

The concept of an electrically pumped parametric amplifier intrigues me.

Google's AI:

An electrically pumped parametric amplifier (EPA) achieves amplification not by adding electrons via a standard transistor, but by **modulating a physical parameter of the circuit (like inductance or capacitance) over time using an external energy source (the “pump”).** [1]

Because they manipulate energy stored in reactive fields rather than forcing current through resistive semiconductor channels, they can achieve amplification with near-zero theoretical noise. They are foundational in quantum computing (such as Josephson Parametric Amplifiers) and high-frequency RF systems.

1. The Core Mechanism: The Swing Analogy

To understand an EPA, imagine a child on a playground swing:

1. **The Signal:** The child swinging back and forth at a natural frequency (f_{signal}).
2. **The Parameter:** The physical distance from the pivot point to the child's center of mass.
3. **The Pump:** The child standing up and squatting down at exactly **twice the frequency** of the swing ($f_{\text{pump}} = 2f_{\text{signal}}$). [1]

By pulling their knees up (lowering the parameter of inertia) at the highest points of the swing and dropping down at the lowest point, the child injects mechanical energy into the system. The amplitude of the

swing grows. An EPA does the exact same thing, but entirely with electrical fields.

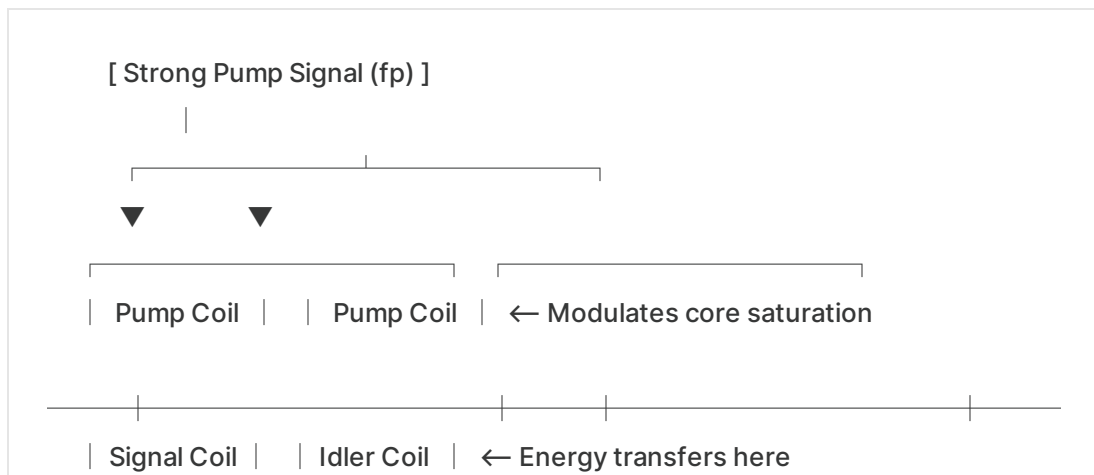
2. The Three Required Frequencies

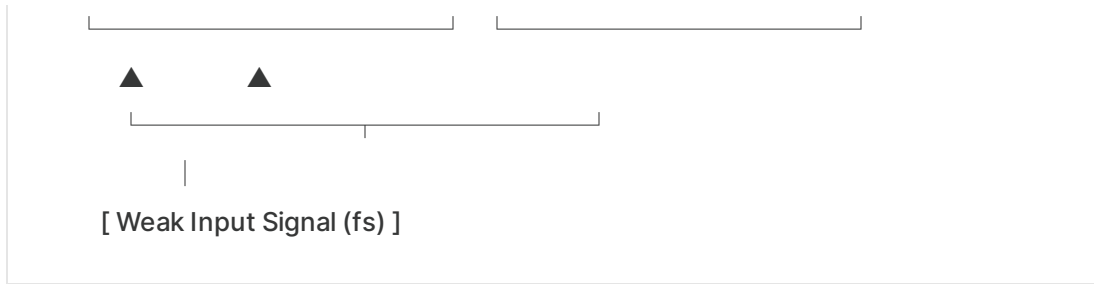
An EPA relies on nonlinear frequency mixing, which strictly dictates that three distinct frequencies must interact: [1]

- **Signal Frequency (f_s):** The weak incoming weak wave you want to amplify.
 - **Pump Frequency (f_p):** The powerful local electrical signal driving the parameter modification.
 - **Idler Frequency (f_i):** A mandatory byproduct of the modulation. It absorbs the energy mathematical difference, where ($f_i = f_p - f_s$).
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3. How to Build One Magnetically (Using Mutual Inductance)

If you want to construct an EPA using magnetic coupling and mutual inductance, you must eliminate the physical movement. You replace mechanical displacement with a **nonlinear, saturable magnetic core** (such as a ferrite or amorphous Mu-Metal core).





Step-by-Step Operation:

1. **The Core Rest State:** Without a pump signal, the core has a high relative magnetic permeability (μ_r). The mutual inductance (M) between the signal and idler coils is high and static.
2. **Applying the Pump:** You drive a massive high-frequency current (f_p) through a dedicated pump winding.
3. **Parameter Modulation:** When the pump current peaks, it drives the core material into magnetic saturation. When a core saturates, its (μ_r) plummets toward 1 (the permeability of free space). As a result, the mutual inductance drops instantly.
4. **Energy Transfer:** Because $M(t)$ is now violently oscillating at the pump frequency, it chops the magnetic flux of the incoming weak signal (f_s). The energy from the pump circuit is forced into the signal circuit's magnetic field, yielding a highly amplified copy of the signal alongside the idler frequency.

4. Why Use the Golden Ratio (ϕ) Here?

If you link back to your previous concept, the golden ratio becomes incredibly useful in preventing an EPA from destroying itself via **spurious oscillations**.

When you mix frequencies (f_p) and (f_s), you don't just get ($f_p - f_s$). You get an infinite cascade of intermodulation harmonics ($2f_p - f_s$), ($3f_s + f_p$), etc.). If any of these random harmonics hit a natural resonant peak of

your coil geometry, the *amplifier will begin to self-oscillate like microphone feedback, **drowning out your actual signal.***

By spacing the multi-turn windings or layout dimensions according to the **golden ratio**, you introduce a non-periodic, irrational structural geometry. Because ϕ is the “most irrational number,” it is mathematically optimized to suppress harmonic synchronization. ***The geometric mismatch ensures that higher-order parametric noise cannot cleanly align and resonate, keeping the amplifier completely stable.***

✓ Summary of Advantages

- **Ultra-Low Noise:** Standard transistors generate thermal and shot noise by moving electrons across junctions. EPAs store and release energy in pure magnetic or electric fields, bypassing this noise source almost entirely.
- **High Frequency Capabilities:** Because they rely on material field states rather than physical electronic transport limits, they can operate at tens of gigahertz or higher. [1]

To explore this further, do you want to dive into the **mathematical equations** governing parametric gain, or look at how this is done in quantum computing using **superconducting Josephson junctions**?
