

Gemini

PRO



a bass guitar, the notes that should trigger a room resonance might be slightly "off-key" compared to the mathematical ideal.

3. "Phasiness" at the Crossover

This is the biggest risk for your hybrid model. If your FDTD wave is lagging by even 2–3 milliseconds at 500Hz, and your Ray Tracer (which is perfectly timed) is providing the 501Hz+ data:

- **What you hear:** A "hollow" or "comb-filtered" sound right at the crossover point. It sounds like a bad crossover on a PA system—there's a "dip" in the energy because the two engines are out of phase.

Is it audible at 10 nodes per wavelength?

At the resolution we discussed ($\Delta x \approx 6.8\text{cm}$), the dispersion error is actually very low.

- **Perception:** For a standard 2-second IR, the lag at 500Hz would likely be sub-millisecond. Most users wouldn't "hear" the dispersion as a separate artifact; it would just feel like the room has a slightly different "texture."

How to "Tune" it out

To make your 500Hz crossover "seamless," you have two engineering options:

1. **Oversampling:** If you push the grid to 15 or 20 nodes per wavelength, the dispersion error at 500Hz becomes mathematically negligible, but your "17 billion ops" doubles or triples.
2. **Phase Compensation:** You can artificially delay the Ray Tracer's output by a few samples to match the FDTD wave.

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