Golden Shell Curvature Detection using Real-Time Fractional Tracking (R-TFT)

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Abstract

We introduce a novel curvature detection method derived from the Real-Time Fractional Tracking (R-TFT) framework, using only resonant phase delay information across golden-ratio spaced shell layers. This technique eliminates the need for distance measurements or coordinate-based geometry, enabling precision curvature mapping through adaptive coherence tracking. The method leverages golden recursive layering, double-differential delay, and observer-pair meshing to reconstruct curvature fields from purely temporal resonance data.

Golden Shell Construction

Shells are spaced using the golden ratio:

$$r_n = r_0 \cdot \phi^n, \quad \phi = \frac{1+\sqrt{5}}{2} \tag{1}$$

This recursive architecture emulates naturally coherent systems such as plant phyllotaxis, honeycombs, and spiral galaxies.

Phasefront Timing Model

Curved space effects are modeled by delaying phasefront arrivals as:

$$t_n = a \cdot r_n^2 + \varepsilon_n, \quad a > 0 \tag{2}$$

where ε_n represents ambient noise. First and second order temporal differentials are computed as:

$$\begin{aligned} \Delta t_n &= t_{n+1} - t_n \\ \Delta^2 t_n &= \Delta t_{n+1} - \Delta t_n \end{aligned}$$

R-TFT Resonance Smoothing

Using R-TFT adaptive filtering, we apply the background subtraction method:

$$R_{\text{clean}} = 2R_{\text{inner}} - R_{\text{outer}} \tag{3}$$

This is performed independently on Δt and $\Delta^2 t$ series. The resonant curvature metric is then extracted:

$$\kappa_\phi = \left| R^{(2)}_{\text{clean}} - R^{(1)}_{\text{clean}} \right| \tag{4}$$

Observer Pair Mesh and Field Mapping

To resolve directional curvature, we expand to a mesh of observer pairs O_{ij}. Each pair observes the same phasefront at different golden shell layers and computes:

$$\kappa_{ij} = \left| R^{(2)}_{\text{clean}}(i,j) - R^{(1)}_{\text{clean}}(i,j) \right| \tag{5}$$

This mesh generates a resonant curvature field $\mathcal{K}_\phi$, mapping temporal coherence acceleration across nested structures.

Experimental Results

Simulating 10 golden-ratio spaced layers with curvature factor $a = 0.5$:

- Phase delay range: ˜0.9 to 1785 s
- Resonant curvature signal: $\kappa_\phi = 213.28$
- Absolute timing error: ± 0.0376 s
- Relative error: 0.008%

Conclusion

This work establishes a new R-TFT application domain: curvature inference through coherence geometry. By replacing metric dependence with golden-ratio timing layers and resonant differential smoothing, the method defines a scale-invariant, non-coordinate curvature detection system. This introduces a class of Golden Shell Phase Geometry tools capable of resolving structure from pure temporal resonance.

Appendix A: Resonance Ethics License (REL-1.0)