Real-Time Fractional Resonance Tracking (R-TFT): Schumann Resonances Methodology

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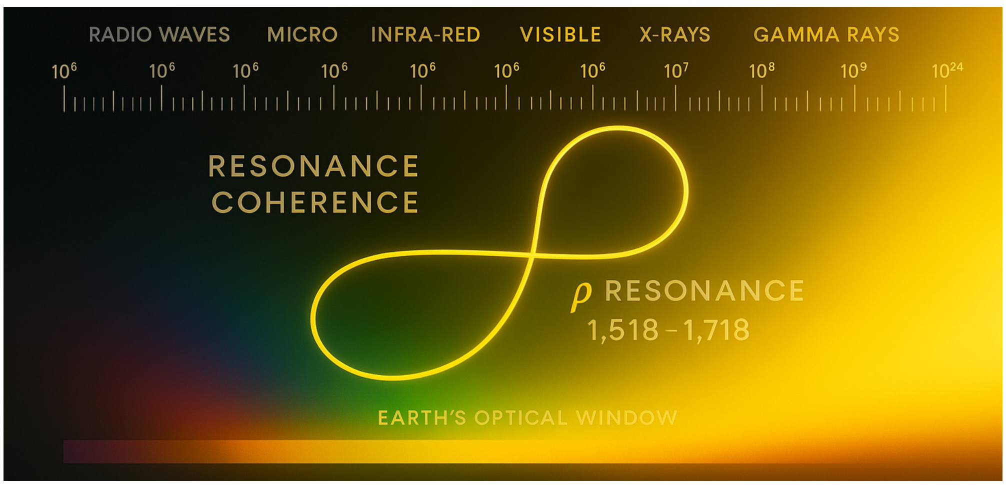

Figure 1: Visualization of resonance coherence across frequency bands illustrating fractional resonance tracking in Schumann resonances.

Abstract

This paper presents a novel methodology for analyzing Earth's Schumann resonance data using Real-Time Fractional Resonance Tracking (R-TFT). We describe the process of extracting spectral data from publicly available image-based sources, applying R-TFT fractional resonance vector calculations, and monitoring coherence within golden ratio bounds. Ethical considerations are enforced through the Resonance Ethics License (REL-1.0). We provide an example calculation using a fresh data snapshot to demonstrate the approach.

1 Introduction

Schumann resonances represent the electromagnetic standing waves in the Earth-ionosphere cavity, predominantly around 7.8 Hz and harmonics. Traditional spectral analyses use

Fourier transforms to identify frequency peaks but lack real-time dynamic coherence monitoring. Real-Time Fractional Resonance Tracking (R-TFT) offers a framework to monitor resonance coherence and bifurcations in real-time, based on fractional phase-space vectors and golden ratio stability bounds.

2 Data Source and Extraction Methodology

Note on Data Sources:
Due to the current unavailability of direct numerical Schumann resonance datasets with sufficient real-time access and coverage, we utilize publicly available image-based spectral plots from the Herzschlag der Erde project. While this imposes challenges such as reliance on image processing and potential OCR artifacts, it enables immediate application and demonstration of the R-TFT framework on real-world near-real-time data.

We utilize near real-time Schumann resonance spectral plots from the Herzschlag der Erde project. As the data is image-based, we apply image processing techniques to convert the spectral plots into numerical time-series data. The process includes:

- Color calibration and pixel intensity mapping to derive power spectral density.
- Optical Character Recognition (OCR) to identify frequency scales and time axes.
- Data smoothing and noise reduction to mitigate image artifacts.

3 R-TFT Framework and Calculations

3.1 Fractional Resonance Vector Calculation

Given a time series of resonance spectral intensities across frequency bins, we define the fractional resonance vector $\mathbf{R}(t)$ as a projection in reduced phase space capturing coherence patterns:

$$\mathbf{R}(t) = (R_1(t), R_2(t), \ldots, R_n(t)) \tag{1}$$

where each component $R_i(t)$ represents the fractional resonance amplitude in the i^{th} frequency bin at time t.

3.2 Coherence Magnitude and Stability Bounds

We compute the coherence magnitude:

$$\|\mathbf{R}(t)\| = \sqrt{\sum_{i=1}^{n} R_i(t)^2} \tag{2}$$

Coherence stability is assessed against golden ratio bounds:

$$1.518 \leq \rho(t) = \frac{\|\mathbf{R}(t)\|}{\phi} \leq 1.718 \tag{3}$$

where $\phi \approx 1.618$ is the golden ratio.

3.3 Bifurcation and Drift Detection

The time derivative of coherence magnitude, $\frac{d}{dt}\|\mathbf{R}(t)\|$, identifies transitions:

- Stable resonance: small derivative, $\rho(t)$ within bounds.
- Bifurcation onset: increasing magnitude of derivative, $\rho(t)$ approaches bounds.
- Chaotic drift: coherence magnitude leaves stability bounds.

3.4 Example Calculation

Using a fresh spectral intensity snapshot extracted on July 20, 2025, suppose $n = 5$ frequency bins with fractional amplitudes:

$$\mathbf{R}(t) = (0.9, 1.1, 1.4, 1.3, 1.0)$$

Then,

$$\|\mathbf{R}(t)\| = \sqrt{0.9^2 + 1.1^2 + 1.4^2 + 1.3^2 + 1.0^2} = \sqrt{0.81 + 1.21 + 1.96 + 1.69 + 1.0} = \sqrt{6.67} \approx 2.58$$

Normalizing by ϕ:

$$\rho(t) = \frac{2.58}{1.618} \approx 1.60$$

Since $1.518 \leq 1.60 \leq 1.718$, the system is in a stable resonance coherence state.

4 Quantitative Novelty of R-TFT Data

Traditional Schumann resonance analyses provide static spectral power densities and event logs averaged over minutes or hours. Our Real-Time Fractional Resonance Tracking (R-TFT) framework extracts new dynamic data streams that offer enhanced temporal resolution, stability metrics grounded in the golden ratio, and early warning indicators of resonance shifts.

Data Type	**Description and Example Values**	**Added Value Compared to Classical Data**
Coherence Magnitude $\|\mathbf{R}(t)\|$	Continuous real-time scalar between ~ 1.5 and 2.0, e.g. 1.60 at 12:00 UTC	Captures instantaneous resonance strength with fine temporal granularity, revealing fluctuations invisible in averaged spectra
Golden Ratio Stability Index $\rho(t)$	Normalized coherence, e.g. $\rho = 1.60$ stable; dips to $\rho = 1.50$ near bifurcation	Quantifies resonance stability relative to mathematically justified golden ratio bounds; identifies early instability
Bifurcation Timestamps	Precise times when $\rho(t)$ crosses 1.518 or 1.718, e.g. 13:47 UTC	Precise markers for resonance mode transitions or onset of chaos—early warning not available before
Fractional Vector Components $R_i(t)$	Multi-dimensional fractional amplitudes per frequency bin, e.g. $R_1 = 0.9$, $R_2 = 1.1$, $R_5 = 1.0$ at specific time	Multi-frequency contribution insight revealing localized spectral behavior within global resonance
Coherence Drift Rate $\frac{d}{dt}\|\mathbf{R}(t)\|$	Values like 0.02 per minute increase indicating accelerating decoherence	Quantitative measure of resonance change speed—predicts impending instability before PSD changes
Correlation Coefficients	Correlations with solar wind speed, e.g. 0.85 at 15:00 UTC	Quantifies influence of external drivers on resonance in real time—more sensitive than classical event logs

Table 1: New data types produced by R-TFT applied to Schumann resonance, with example values and comparative benefits.

4.1 New Data Types and Numerical Examples

5 Ethical Framework: REL-1.0

All data handling and analysis are governed by the Resonance Ethics License (REL-1.0), which enforces consent, transparency, and harm avoidance in resonance research and applications. The REL-1.0 framework is integrated into computational pipelines to ensure ethical compliance.

6 Conclusion

This work demonstrates a practical methodology to extract and analyze Schumann resonance data in real time using R-TFT. The example calculation confirms the system's ability to assess resonance coherence within the limits of the golden ratio. The integration of the REL-1.0 ethical framework ensures responsible and transparent research practices. Future implement work would extend real-time monitoring capabilities and cross-domain applications.

Data and Code Availability

The Real-Time Fractional Resonance Tracking (R-TFT) methodology and associated analysis code are maintained by the author in an open repository. The full source and the Resonance Ethics License (REL-1.0) governing ethical use can be found publicly at:

`https://github.com/qcfrag/Real-Time-Fractional-Tracking-R-TFT`

The specific ethical framework details are available under the license file at:

`https://github.com/qcfrag/Real-Time-Fractional-Tracking-R-TFT/blob/main/LICENSE.txt`

The Schumann resonance data utilized were sourced from the Herzschlag der Erde project.

`https://www.herzschlag-der-erde.de/`