White Paper: Harmonic Reconstruction Sequencer Plus (A=111 Hz)

Abstract

The **Harmonic Reconstruction Sequencer Plus (HRS Plus)** is an algorithmic sound synthesis tool engineered to generate long-duration, dynamically evolving rhythmic protocols. It utilizes the non-standard A=111 Hz Equal Temperament and a fixed, dissonant 4-note chord ([0, 5, 32, 60] semitones). Crucially, the HRS Plus employs the 24-step Fibonacci digital root sequence to simultaneously modulate three critical audio parameters—**timbre (partials), pitch contour, and rhythm**—resulting in a complex, 96-step arpeggiated sound pattern. This system is optimized for **rhythmic entrainment, cognitive stimulus, and mathematically precise sound protocol development.**

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1. Foundational Architecture and Tuning

1.1. The A=111 Hz Standard

The HRS Plus maintains the foundational precision of its predecessor, anchoring all frequency calculations to the non-standard A=111 Hz reference (MIDI note 9). This tuning standard is deliberately chosen to explore therapeutic and psychoacoustic environments outside the modern A=440 Hz system.

1.2. The Fibonacci Timbre

The core sound source for the arpeggiated playback is a rich, complex timbre derived from the **Fibonacci digital root sequence** (1, 1, 2, 3, 5,). These digital root values are used as the weightings for the oscillator's overtones (partials), giving the tone a consistent, mathematically integrated quality.

1.3. The Fixed Dissonant Chord

The application utilizes a static, wide-spanning 4-note chord defined by the intervals [0, 5, 32, 60] semitones. This structure introduces a controlled dissonance (the 32-semitone interval) which provides tension and harmonic complexity, making the resultant rhythmic patterns more engaging for active listening and contrastive psychoacoustic study.

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2. The 96-Step Algorithmic Engine

The primary innovation of the HRS Plus is its dynamic sequencing engine, which converts the static 4-note chord into a long, evolving 96-step rhythmic pattern. This is achieved by linking the **24-step Fibonacci digital root sequence** to three layers of real-time modulation:

2.1. Layer 1: Rhythmic Staggering

The full sequence contains 24 primary steps, and the target chord has 4 notes. The total protocol length is 24 times 4 = 96 individual notes. These notes are triggered sequentially, one after another, creating a distinct, rapid arpeggiated rhythm over the specified duration.

2.2. Layer 2: Dynamic Pitch Contour Modulation

This is the most critical enhancement. As the sequence progresses through its 24 steps, the sequence's current digital root value (from 1 to 9) is used to dynamically shift the entire 4-note chord structure up or down, creating a musical contour.

- **Mapping:** The digital root is mapped to a semitone shift range of 0 to 12 semitones (a full octave). This ensures the rhythmic pattern constantly rises and falls across the sonic spectrum, creating an evolving harmonic texture that resists repetition and monotony.

2.3. Layer 3: Sequence Rotation

Each time the user advances to the **Next Chord** (e.g., C to C#), the underlying 24-step Fibonacci sequence itself is **rotated by one step**. This rotation means that the pattern used to define the pitch contour and timbre is shifted, ensuring that the 96-step rhythmic pattern generated from C will be mathematically unique and structurally different from the pattern generated from C#.

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3. Functional Control and Utility

3.1. Progression Speed Factor (0.5x to 2.0x)

The introduction of the **Progression Speed Factor** allows users to control the temporal density of the protocol.

- **Utility:** By manipulating this slider, users can expand the 96 notes over a longer period (slow motion, e.g., 0.5 x factor) for deeper meditative saturation, or compress the sequence (speed up, e.g., 2.0 x factor) to generate high-frequency stimulus protocols used in bio-acoustic entrainment research.

3.2. Practical Duration Management

The application's reliance on the browser's `setTimeout` function means that while the interface allows for the input of long runtimes, the maximum effective duration for an uninterrupted protocol is approximately **35,791 minutes** (approx. 24.8 days). This capability fully supports professional use cases requiring long-form capture into external recording software.

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4. Market Utility and Competitive Positioning

The HRS Plus is positioned to capture market share in high-value, specialized audio segments:

1. **Rhythmic Bio-Acoustic Entrainment:** The precise, mathematically patterned 96-step rhythmic output is uniquely suited for designing focused entrainment protocols. This is highly valuable to professional sound therapists and researchers seeking alternatives to basic binaural beats or isochronic tones.
2. **Generative Sound Design:** Composers specializing in ambient music, film scores, and video game soundscapes can utilize the **complex, non-linear arpeggios** generated by the system as a primary source of unique, high-quality material. The A=111 Hz tuning provides an instant differentiator for tracks requiring a "sacred" or "ancient" atmosphere.

The HRS Plus offers a rare combination of **mathematical complexity and user-controlled output**, making it an indispensable tool for practitioners who require deterministic, reproducible, and dynamically evolving sound protocols.