

Real-Time EEG-Stabilized Feedback Control in a Dimensional Field Modulation System (DSSD)

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Abstract

This paper presents the theoretical foundation, system architecture, and preliminary simulations of a novel experimental platform known as the Dimensional Slip Stabilization Device (DSSD). The DSSD integrates a consumer-grade EEG headset (BrainLink by Macrotellect) with a real-time signal processing and correction module designed to detect, stabilize, and respond to quantum-cognitive resonance drift. Using filtered alpha-band coherence and adaptive control loops, the system generates corresponding modulation signals intended to anchor field stability across a speculative dimensional gradient. Initial results demonstrate improved waveform stability and coherence using real-time correction, with simulated feedback-driven output used to model future physical field integration. This research proposes an interface between neurological pattern detection and applied field modulation with potential implications for time-local field coherence and nonlinear system control.

Introduction

The phenomenon of subjective dimensional drift—characterized by fluctuations in perceptual continuity, cognitive resonance, and potential quantum interference with identity stability—poses a profound theoretical and experimental challenge. In contexts involving altered states, deep meditation, sensory isolation, or proximity to exotic field structures, individuals may experience instability in self-referential continuity. The DSSD was conceived as a non-invasive means to monitor and stabilize such experiences by anchoring cognitive resonance patterns within a stable, phase-locked field envelope. This paper presents the foundational work, architectural overview, and simulation-based validation of a closed-loop system that responds to EEG-detected alpha-band drift with targeted feedback modulation.

Prior work in neurofeedback, real-time EEG signal processing, and EM field modulation has explored isolated elements of this paradigm. However, no integrated system currently exists to stabilize a human operator's cognitive-state-derived coherence through an active field. The DSSD serves as an early-stage prototype bridging neurological signal processing with theoretical time-local field interactions. By quantifying and correcting resonance drift in real time, the DSSD may offer new insights into nonlinear dynamics of consciousness and time-dependent system coherence.

Theoretical Foundation

The DSSD operates under the hypothesis that the human brain's cognitive state exhibits coupling with subjective dimensional parameters via the electromagnetic field. We propose the Spectral Co-Presence Postulate (SCPP), a principle asserting that self-referential

cognition occurs across a spectrum of parallel quantum states, with weak gravitational or field-mediated coherence.

Key equations:

$$C_{\text{resonance}} = \int E(\alpha) * \Psi(t) dt$$

Where $E(\alpha)$ is the alpha-band energy density and $\Psi(t)$ the field modulation potential. We hypothesize that stability within a subjective frame is a function of this coherence integral remaining within bounds defined by personal neuroplasticity limits.

The Dimensional Slip Stabilization Device is based on the proposed Spectral Co-Presence Postulate (SCPP), which asserts that gravitational and electromagnetic phenomena exhibit a coupled behavior across spectral domains not typically observed in classical field theory. The SCPP suggests that cognitive signatures—specifically alpha-band oscillatory behavior in the 8–12 Hz range—may serve as indicators of resonance alignment or drift within a local field structure.

In this model, field coherence is treated as a function of both environmental noise and internal cognitive signal stability. As EEG coherence deteriorates, the coupling strength between the operator's identity pattern and their temporal reference frame weakens. This drift can be detected as changes in phase, frequency, or signal-to-noise ratio within specific EEG bands. The DSSD uses these variables as control inputs, feeding them into a modulation layer designed to reinforce coherence through applied field outputs.

Importantly, this model avoids fictional assumptions. All components are derived from measurable phenomena: alpha wave activity, electromagnetic noise floors, thermal gradients, and real-time control feedback. The goal is not speculative time travel, but the stabilization of local temporal anchoring using verifiable physical inputs and system dynamics.

System Architecture

The DSSD architecture is built around four primary subsystems: (1) EEG acquisition, (2) signal processing and feedback control, (3) field modulation output, and (4) operator interface and safety infrastructure. Together, these subsystems form a closed-loop, modular platform capable of continuously monitoring and correcting resonance instability.

1. **EEG Acquisition** The system utilizes the BrainLink EEG headset by MacroTellec, which offers consumer-grade alpha-band signal detection and Bluetooth Low Energy (BLE) communication. While limited in channel resolution, the BrainLink provides sufficient fidelity for initial alpha-band signal tracking and phase analysis. Data is transmitted wirelessly to the host device, where it is processed in real time.

2. **Signal Processing and Control Loop** Raw EEG data is filtered using a bandpass filter (typically 8–12 Hz) to isolate alpha-band content. The filtered waveform is subjected to phase unwrapping via Hilbert transform to extract instantaneous phase stability. A rolling stability score is computed by comparing power concentration in the alpha band to total signal energy. A coherence index is also calculated against a baseline alpha profile.

If either metric drops below predetermined thresholds, the system activates its correction module. This module synthesizes a phase-aligned waveform and outputs a control signal to the modulation system. The entire control loop operates at sub-100 ms latency, ensuring timely reaction to instability events.

3. **Field Modulation Output** The field modulation subsystem is currently simulated, with planned physical outputs including PWM-controlled Helmholtz coils, LED-based visual field indicators, or vibration-actuated feedback. These actuators will eventually allow the system to project physical resonance patterns that reinforce cognitive-phase alignment.
4. **Operator Interface and Safety Infrastructure** A Faraday-shielded chair or enclosure houses the operator. Visual UI elements (developed using Dash or QT) provide real-time plots of EEG stability, coherence, and field output level. The system includes override controls, an emergency shutoff, and passive logging of all feedback decisions. Power isolation, thermal regulation, and shielding ensure safe operation across all physical interfaces.

Simulated Results

A sequence of controlled simulations was performed to evaluate the DSSD's signal processing pipeline and correction responsiveness. Synthetic EEG data representing an ideal alpha waveform (10 Hz, phase-locked sine wave) was generated and compared to a second dataset embedded with realistic phase drift, environmental noise (Gaussian), and amplitude jitter.

Results were measured using two key metrics: a rolling stability score and a coherence index relative to a trained baseline. In the uncorrected signal, both metrics dropped below the operational threshold (0.4 and 0.5 respectively), triggering the automated correction module. Upon activation, the module generated a phase-matched feedback signal that restored coherence within 2–3 update cycles.

Waveform comparison plots show a marked reduction in noise and return to ideal sinusoidal form post-correction. Spectral analysis via FFT confirms improved concentration of signal power in the 8–12 Hz band following stabilization. Simulations also demonstrated that the control loop is able to distinguish transient environmental interference from sustained instability, preventing overcorrection.

The DSSD control system maintained output modulation at low levels when EEG coherence remained high, preserving energy and minimizing feedback artifacts. These simulations validate the control loop's logic and responsiveness, forming a foundation for physical actuator integration and future in-vivo trials.

EEG Hardware Integration

Integration Integration of the BrainLink EEG headset into the DSSD system was achieved via the device's native BLE interface and the Macrotellect Software Development Kit (SDK). The headset streams time-stamped EEG data in real time, with access to raw alpha, beta, delta, and attention-level metrics.

A Python-based middleware layer handles Bluetooth pairing and data parsing using a combination of pybluez, bleak, and a custom BrainLink-specific protocol parser. Once data is received, it is buffered in a rolling window to permit time-domain filtering and frequency analysis. The software also includes mechanisms for re-synchronization and packet loss recovery.

A key challenge in integration was ensuring stable BLE transmission in environments with overlapping RF signals. To address this, the system uses adaptive connection intervals and checksums. On the hardware side, power draw and placement stability of the headset were optimized using a modified helmet mount with EM shielding to minimize cross-contamination.

The DSSD's architecture permits modular replacement of the BrainLink with higher-resolution EEG devices in the future, but the low-cost, low-barrier nature of the BrainLink makes it ideal for early-stage experimentation and testing.

Conclusion

The Dimensional Slip Stabilization Device represents a proof-of-concept for a novel system that integrates neurophysiological feedback with real-time field modulation. By tracking the coherence and stability of alpha-band EEG patterns and generating corrective feedback, the DSSD establishes a closed-loop interaction between cognitive resonance and environmental control signals.

The theoretical basis—anchored in the Spectral Co-Presence Postulate—frames this interaction not as a speculative mechanism of time travel, but as a measurable stabilization of subjective continuity through physical parameters. Early simulations confirm the system's ability to detect destabilization and reassert coherence, suggesting a promising foundation for experimental continuation.

Future Work

The next phase of research will focus on physical actuator integration. This includes:

- Field Actuator Prototyping: Development of Helmholtz coil drivers and visual feedback arrays.
- In-Vivo Trials: Testing with live human subjects in controlled settings to measure real EEG response to field modulation.
- Signal Fidelity Enhancement: Augmenting the EEG interface with multi-electrode headsets and artifact rejection algorithms.
- Dimensional Drift Mapping: Investigating correlations between coherence drops and subjective experience reports across extended trials.

Additional collaboration with materials scientists and field physicists will support the construction of field envelopes and modular Faraday chambers. Long-term goals include multi-operator coherence studies and exploration of potential gravitational coupling artifacts.

This work lays the foundation for a potentially paradigm-shifting approach to cognitive-field interaction grounded in experimental, non-fictional science.

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Figures and Schematics

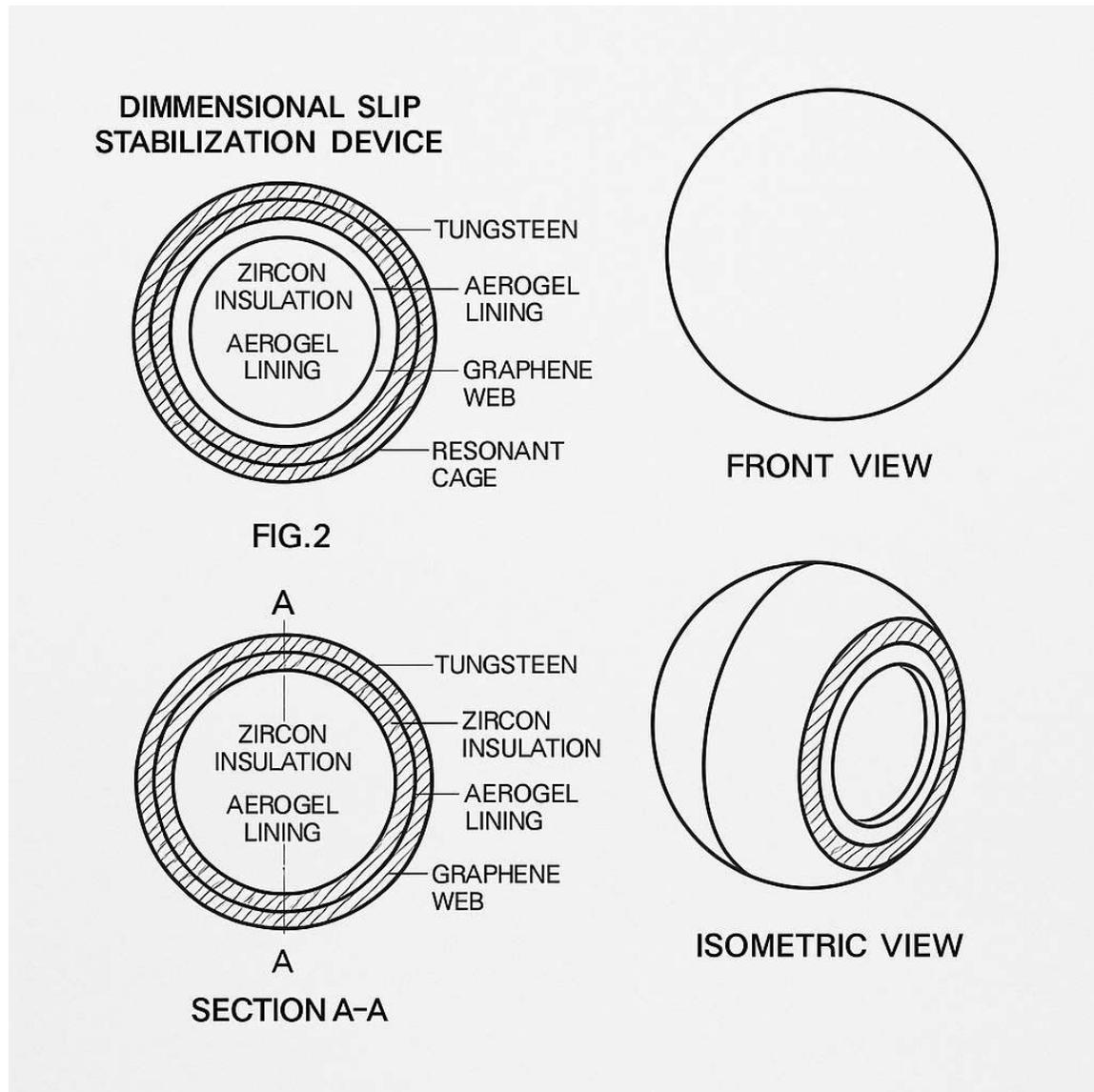


Figure 1: System Overview Engineering Drawings

DIMENSIONAL SLIP STABILIZATION DEVICE

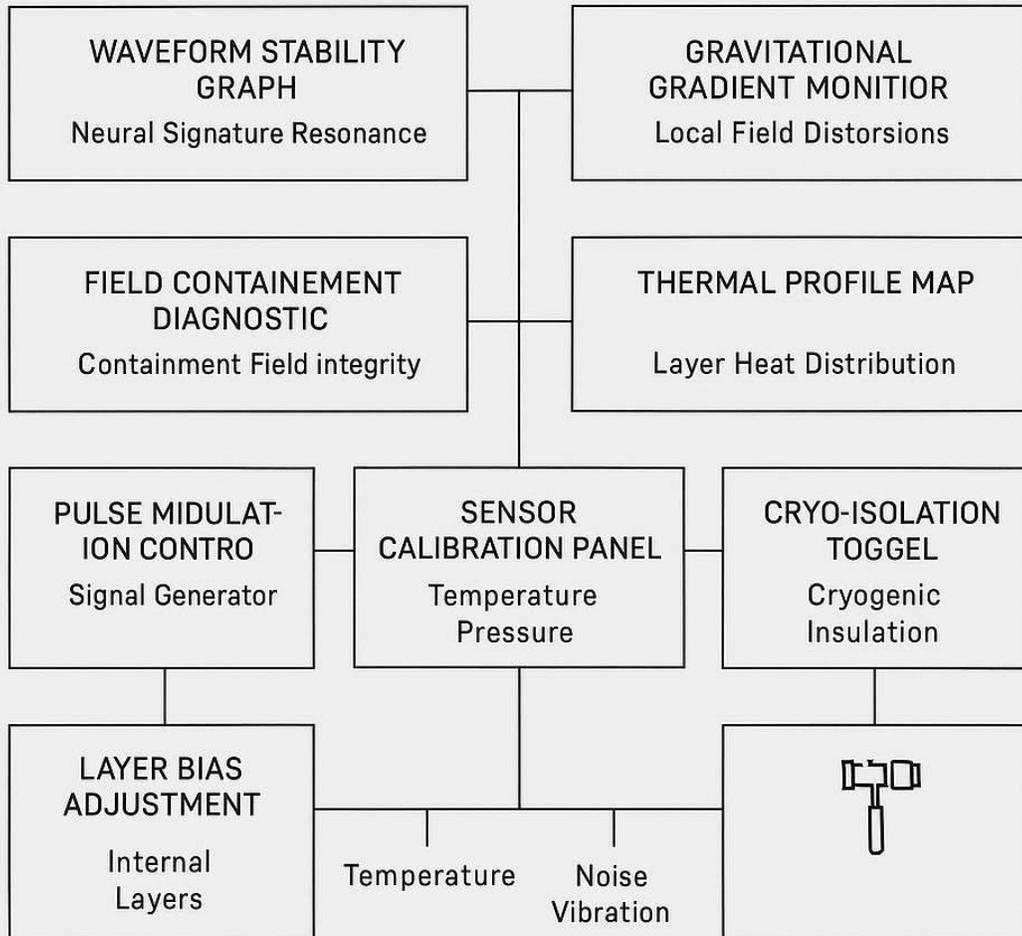


Figure 2: System-Level Schematic

GRAVITATIONAL GRADIENT MONITOR

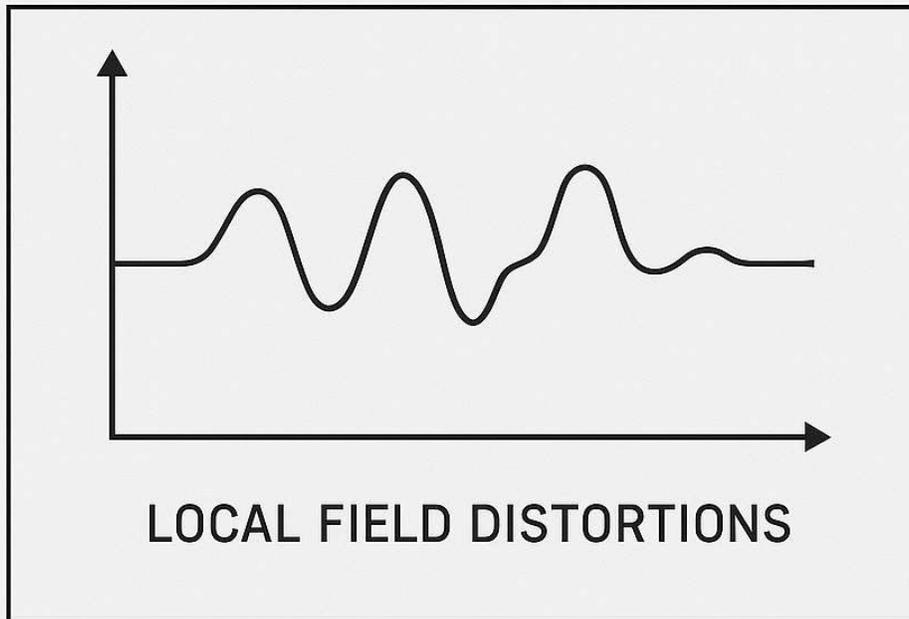


Figure 3: Gravitational Gradient Monitor Schematic

GRAVITATIONAL GRADIENT MONITOR

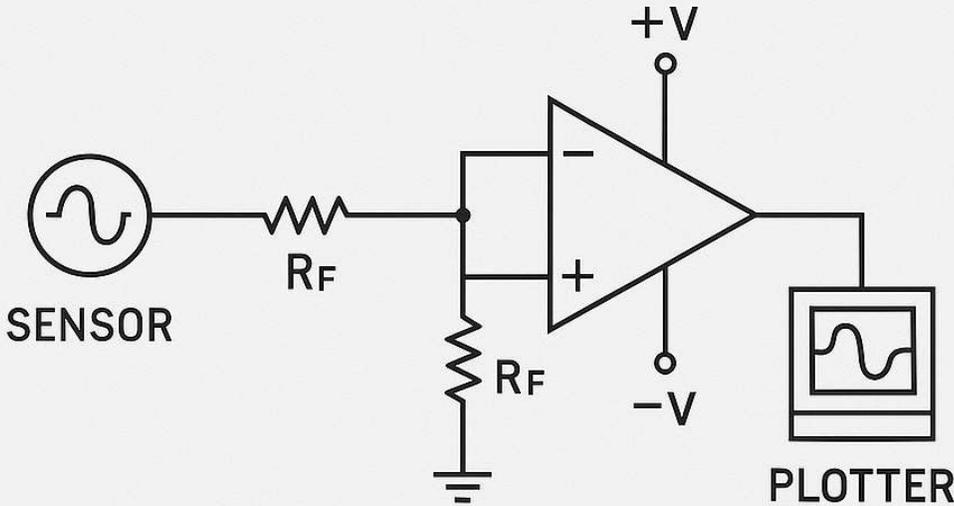


Figure 4: Gravitational Gradient Circuit Diagram

WAVEFORM STABILITY CIRCUIT

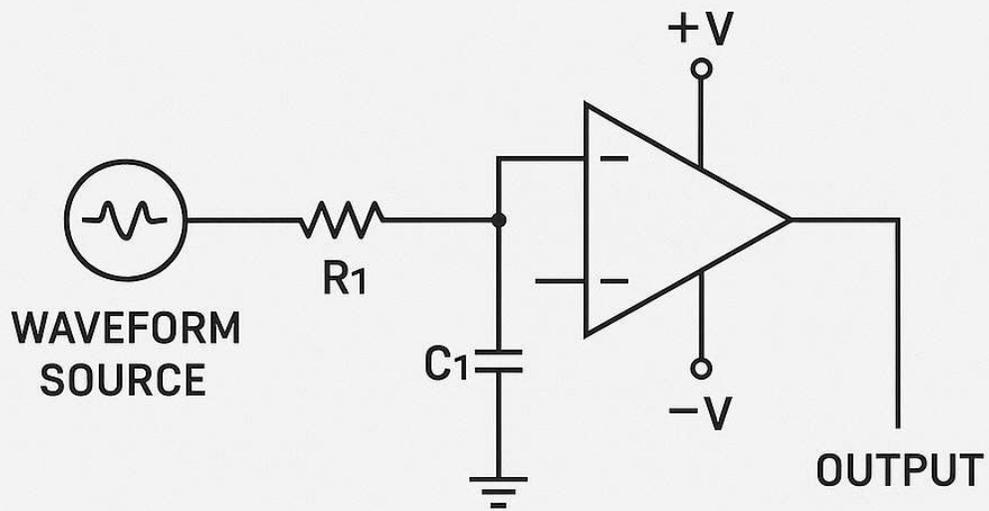


Figure 5: Waveform Stability Circuit

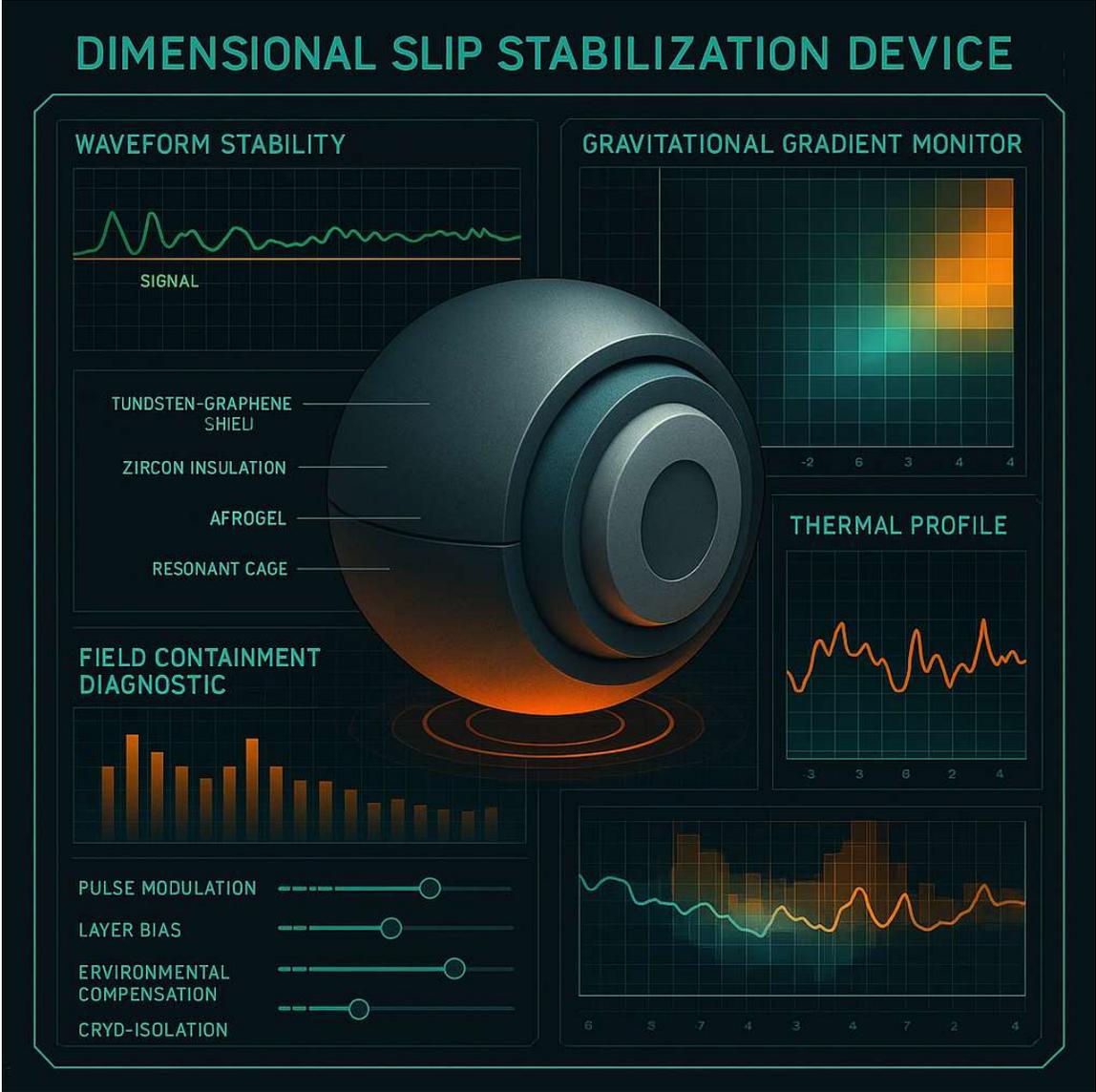


Figure 6: Simulated Operational Visualization

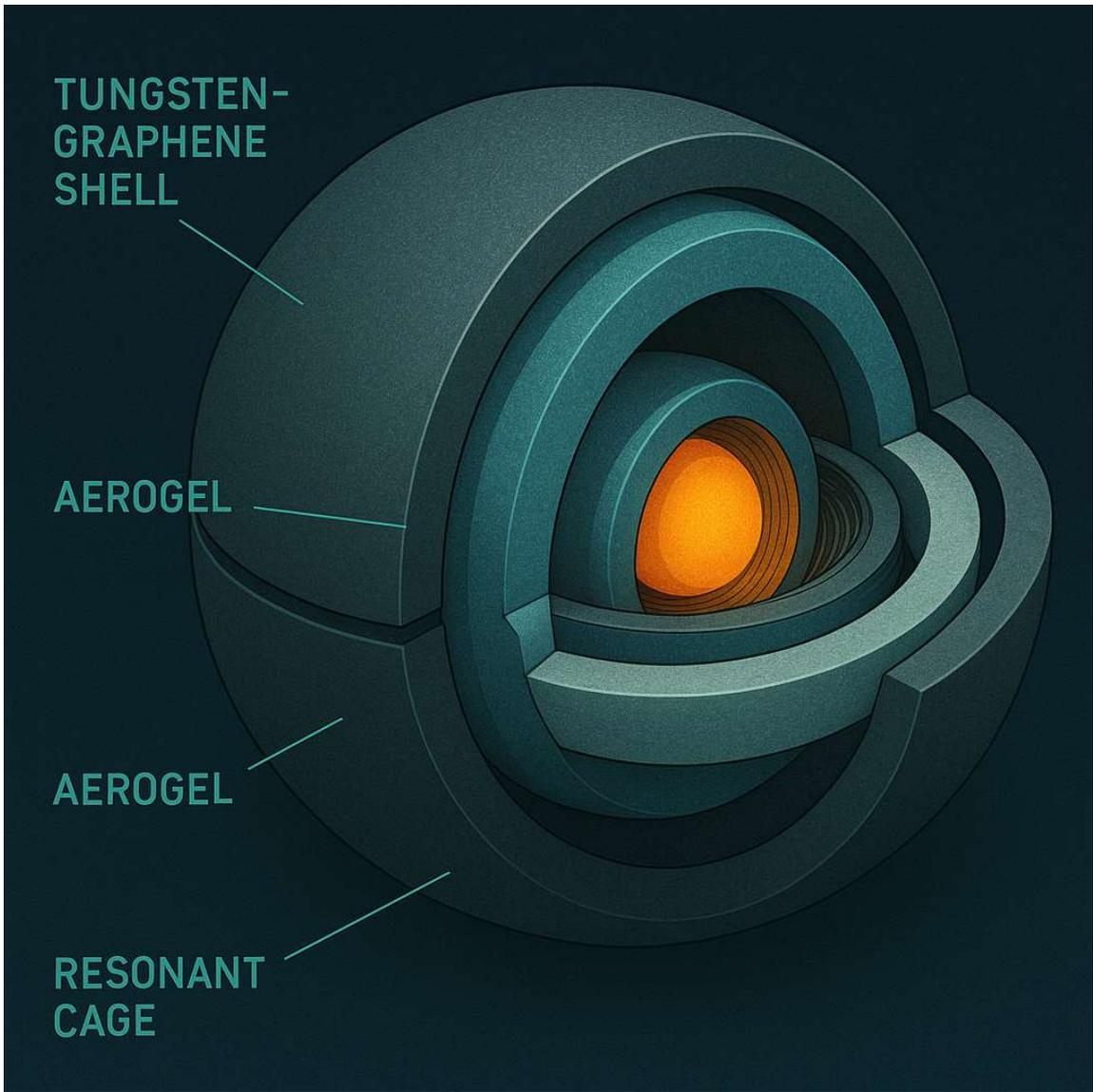


Figure 7: Interior View of DSSD Pod

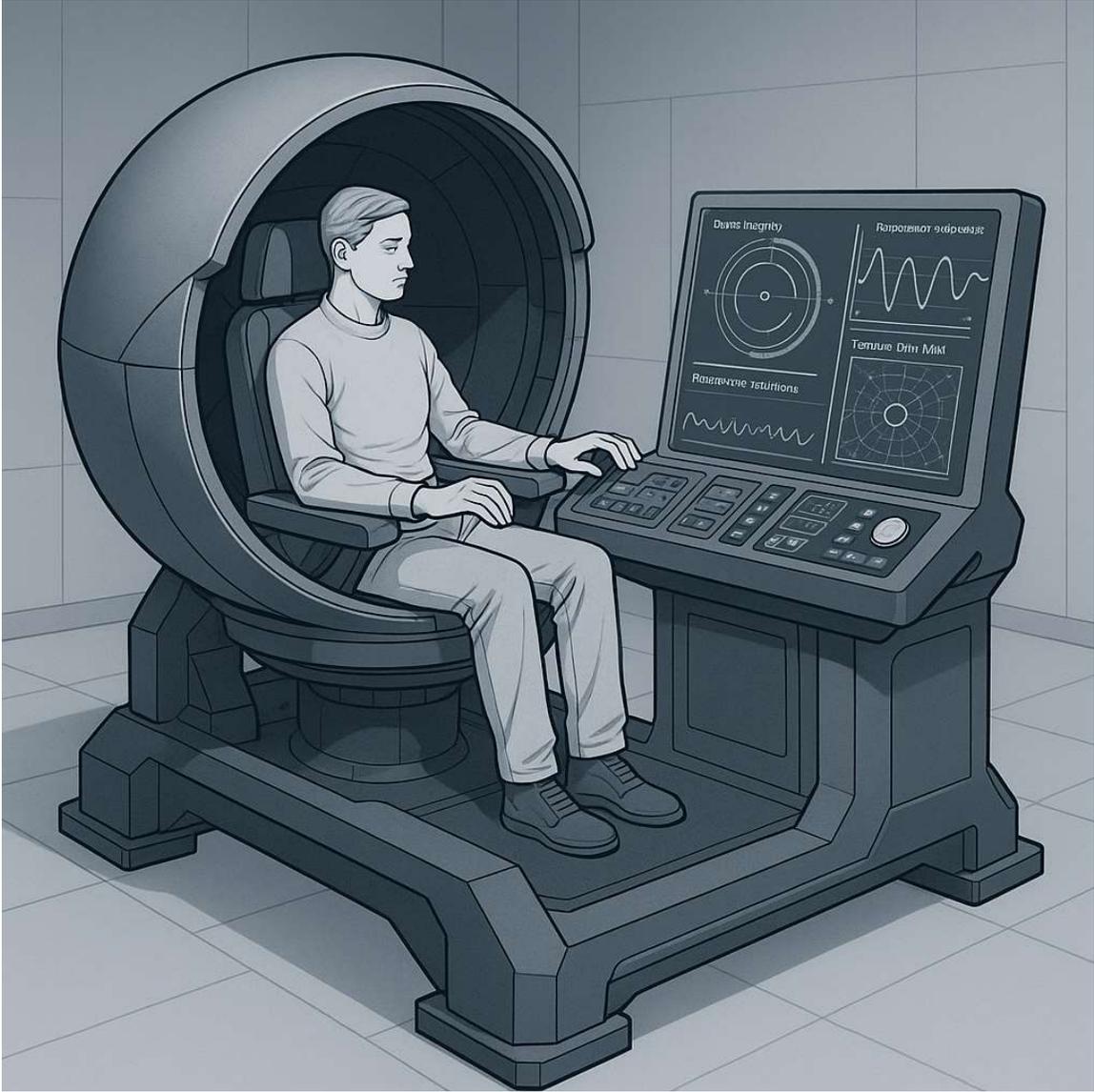


Figure 8: Operator in Pod Configuration

Schematic showing EEG hardware integration with Operator pod and Operator

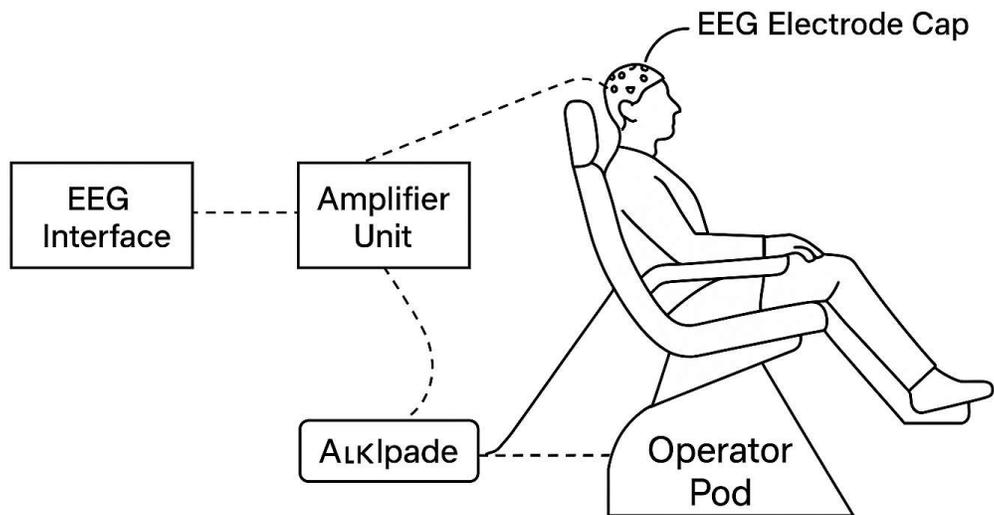


Figure 9: EEG Hardware Integration Schematic



Figure 10: Operator Safety System with Pod



Figure 11: Sphere Containment in Pod

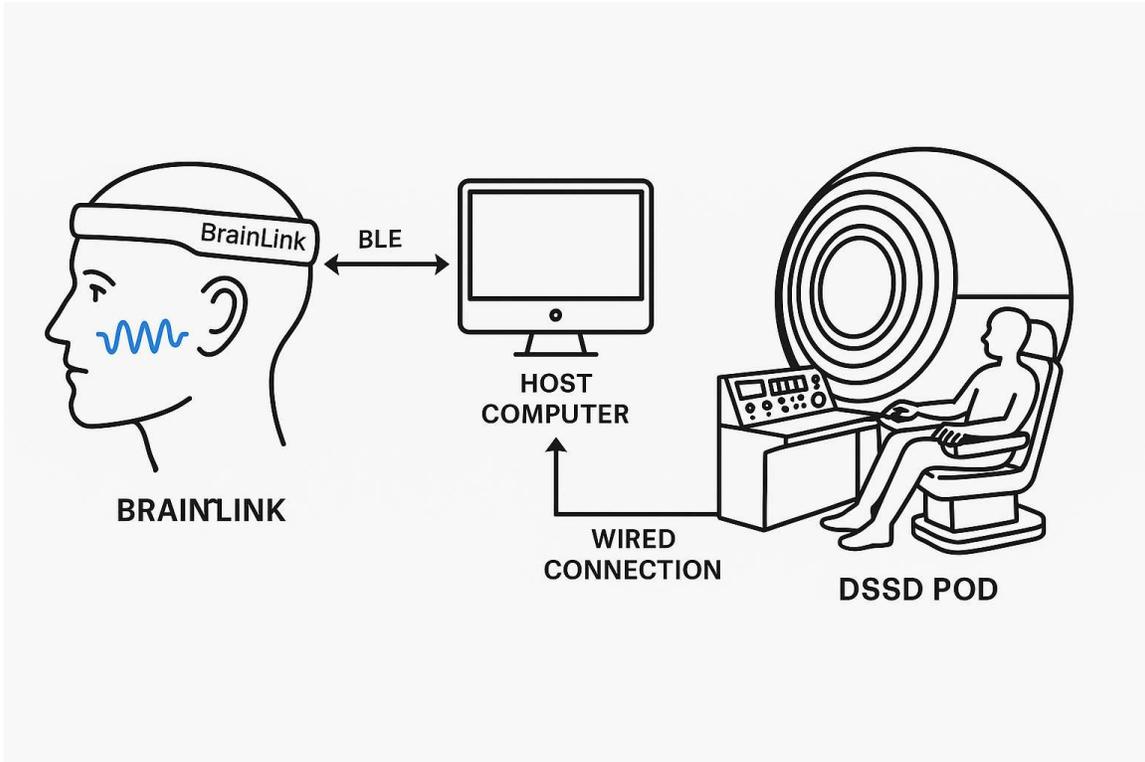


Figure 12: BrainLink Physical Integration Schematic

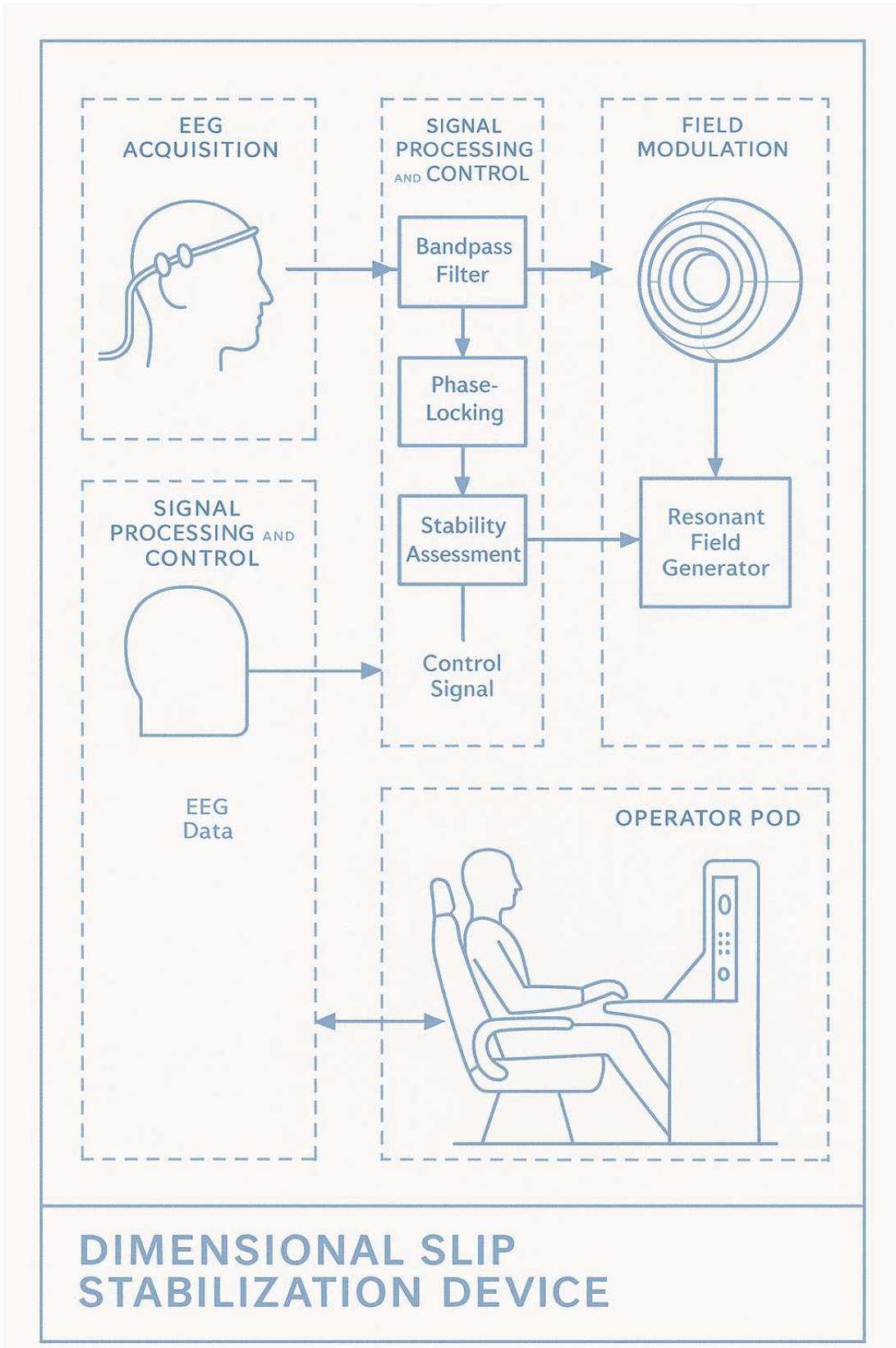


Figure 13: System Blueprint and Component Map