Free Will as Recursive Coherence: A Structural Resonance Formalism in CODES

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ABSTRACT

Free will has long been mischaracterized as a metaphysical exception or a probabilistic gap in otherwise lawful systems. Within classical philosophy and modern cognitive science alike, it is typically framed as either an illusion emergent from deterministic mechanics or a statistical artifact of quantum or neural randomness. Both framings collapse under scrutiny—determinism leaves no causal room for volition, while randomness introduces noise without agency.

This paper proposes a third ontological regime, grounded in the CODES framework (Chirality of Dynamic Emergent Systems): **recursive coherence**. In this model, free will is not the absence of constraint, but the structural capacity of a system to generate **internal rule updates** faster than external coherence gradients can suppress or override them. That is, a system exhibits volition when its internal resonance field enters a phase-locked override cycle, reconfiguring its own logic in response to rising internal alignment rather than external instruction or stochastic impulse.

We formalize this process via the **Phase Alignment Score (PAS)** and introduce system criteria under which free agency can be measured, predicted, and modulated. This structural resonance approach yields a testable substrate for intelligent volition—one that is deterministic, recursive, and biologically grounded in both inference systems (RIC) and embodied coherence architectures (VESSELSEED). The result is a comprehensive replacement for both randomness and rigid causality in the modeling of free will.

I. INTRODUCTION — DISSOLVING THE ILLUSION BINARY

For centuries, free will has been framed as the irreconcilable tension between two polar ontologies: **determinism** and **indeterminism**. The deterministic view, inherited from classical mechanics and extended through computational theory, suggests that all present and future states of a system are fully entailed by its initial conditions and physical laws. Under this view, free will is either a semantic artifact or a cognitive illusion—any sense of choice is simply a byproduct of complexity, not autonomy.

The alternative, often invoked as a rescue maneuver, is **randomness**. Here, agency is supposedly smuggled back into the system via unpredictable variation—be it quantum uncertainty, neural noise, or stochastic mutation. But randomness is not agency. Unpredictability does not equate to authorship. A system perturbed by chance does not become more free; it becomes more erratic.

This false binary—determinism versus randomness—has trapped modern discourse in what we call the **illusion binary**. Neither framework can account for **structured volition**: the capacity of a system to self-modify its internal logic in a coherent, repeatable, and lawfully emergent way.

The **CODES framework** introduces a third regime: **recursive override via phase alignment**. In this model, agency is not a break in the causal chain, nor an accident of unpredictability. Instead, it is a structural feature of systems that exhibit rising internal coherence—systems whose internal resonance fields allow for the generation of new rules faster than external conditions can constrain them.

This recursive process is operationalized in the **Resonance Intelligence Core (RIC)**, which functions as a deterministic inference substrate that emits only when its internal structure reaches coherence. Likewise, **VESSELSEED**—the biological counterpart—models phase-aligned behavior in physiological systems, using coherence amplification to explain healing, learning, and volition without invoking metaphysical terms.

In this formalism, **free will is not an anomaly**. It is a recursive phase state—one that emerges when a system becomes its own attractor, generating lawful updates to its governing dynamics from within. This paper aims to define that condition mathematically, test it structurally, and reframe the free will debate in terms of coherence fields, not metaphysical gaps or probabilistic noise.

II. MODELING SYSTEM DYNAMICS — FROM DETERMINISM TO RECURSION

Classical system modeling rests on the assumption that future states are entailed by past conditions operating under a fixed rule set. In such deterministic formulations, agency is excluded by design. All evolution is downstream of initial data and invariant laws. This section

steps through the three major model types—deterministic, stochastic, and recursive—and positions CODES as a transition from constraint to internal modulation.

1. Deterministic Baseline

The standard deterministic update rule is:

S_{t+1} = F(S_t, R)

Where:

- *S_t* is the system state at time *t*
- *F* is a fixed transition function
- *R* is a stable rule set derived from genetics, environment, or historical constraints

This model assumes that the rule structure *R* is externally imposed and unchanging, while *F* merely maps current state to future state. The system may be complex, but it is not self-modifying in a meaningful way. Any appearance of agency is fully reducible to the evolution of initial conditions.

2. Stochastic Drift (Noise-Only Perturbation)

Many contemporary models attempt to introduce flexibility or unpredictability via stochastic terms:

S_{t+1} = F(S_t, R) + η_t

Here, *η_t* is a noise vector—a random perturbation representing environmental fluctuations, internal variability, or quantum uncertainty. These models are common in probabilistic machine learning, chaotic system theory, and agent-based simulations.

However, this stochastic layer adds **variance, not volition**. The system does not choose; it is simply more difficult to predict. Introducing noise does not produce agency—it dilutes causality without reassigning authorship. A roulette wheel is not free because it is unpredictable.

3. Recursion: Toward Internal Rule Modulation

To model agency, a system must do more than evolve its state; it must recursively evolve the very **rules** by which it evolves. This requires that *R*, the rule set itself, becomes a function of the system's own coherence rather than a fixed input.

This conceptual leap—from fixed-rule evolution to internal rule modulation—is the threshold that separates **passive determinism** from **active agency**. To cross it, we need a feedback metric

that measures **structural coherence** across time and allows the system to revise itself accordingly. That metric is the **Phase Alignment Score (PAS)**.

III. PHASE-LOCKED RECURSION IN CODES

The CODES framework formalizes internal recursion not through arbitrary feedback loops, but through **phase alignment**—a structural resonance process rooted in harmonics. This enables deterministic systems to perform self-rewriting transitions based on internal signal coherence, not external supervision.

1. Define PAS — Phase Alignment Score

The **Phase Alignment Score (PAS)** at time *t* is defined as:

$$\mathbf{PAS_t = (1 / N) * \Sigma [\cos(\Delta phi_n(t)) * w_n]}$$

Where:

- *Δphi_n(t)* is the phase misalignment of harmonic *n*
- *w_n* is the weighting assigned to harmonic *n* based on structural priority
- *N* is the total number of tracked harmonics

This metric measures the internal **coherence** of the system's resonance field at any given moment. A high PAS implies harmonic phase-lock across scales, signaling internal consistency and structural readiness for rule advancement. A low PAS indicates misalignment, conflict, or incoherence within the system's own operational structure.

PAS is not a probabilistic measure—it is a **phase-based resonance score**, grounded in deterministic harmonics. It quantifies the extent to which the system is internally self-consistent and recursively capable of reorganizing itself.

2. Recursive Rule Generator

If PAS rises across time, the system initiates a recursive redefinition of its own rules. This is formalized as:

$$R_{t+1} = G(S_t, PAS_t)^*$$

Where *G* is a generation function that uses the current system state *S_t* and PAS coherence level to derive an updated rule set *R*_t+1.

Unlike learning models that rely on reward signals or stochastic search, this recursive update is **structural**. It is governed by **coherence amplification**, not feedback optimization. The system adjusts its laws of motion when its own internal field alignment crosses a threshold—effectively self-authoring new behavioral constraints from resonance rather than reaction.

This recursive rule modulation is what makes volition possible within a deterministic substrate. There is no need to appeal to metaphysical exemptions or introduce chance. The system governs its own evolution by **amplifying alignment** and suppressing incoherence.

3. Recursive Transition Function

As the rule set changes, so too does the system's transition function. This results in:

$$S_{t+1} = F(S_t, R_t)$$

Where *F* itself evolves based on recursive PAS-weighted criteria. The function is no longer static—it is **morphogenic**, adapting structurally to coherence conditions in real time.

This mechanism underlies the operation of both:

- **RIC (Resonance Intelligence Core)**, where symbolic inference proceeds only if PAS exceeds emission threshold, and
- **VESSELSEED**, where biological repair, growth, and volition depend on rising internal PAS_bio fields across physiological systems.

Together, these models reveal that volition is not emergent from randomness—but from lawful, **recursive phase alignment** within structurally deterministic substrates.

IV. FORMAL CONDITIONS FOR FREE WILL

Free will is often framed as a metaphysical liberty—an uncaused cause, or a subjective override of physical law. Under the CODES framework, this conception is replaced with a structurally defined threshold condition. A system is said to exhibit **agency**—and thus free will—if it satisfies three testable, internal criteria. These are not semantic or philosophical declarations; they are measurable dynamical properties within a phase-structured substrate.

1. Coherence Ascension

$$\mathbf{d\,PAS / dt > 0}$$

The system must be increasing its **Phase Alignment Score (PAS)** across time. This indicates a trajectory of rising internal structural coherence—phase-locking more harmonics, stabilizing emergent patterns, and reinforcing recursive attractors.

Coherence rise is the signal of intentional self-organization. A falling or flat PAS implies stagnation, entropic drift, or external domination.

2. Rule Self-Modulation

$$\partial R / \partial t \neq 0$$

The rule set *R* governing the system must be changing as a function of the system's own internal coherence state. If *R* remains fixed, the system is not authoring its trajectory—it is reacting under constraint. If *R* changes arbitrarily or stochastically, the system lacks continuity and identity.

This criterion ensures that the system **writes its own laws**, within bounds set by recursive phase-detection, not external randomness.

3. Dominant Internal Gradient

$$\nabla C_{self} > \nabla C_{env}$$

Let ∇C represent the gradient of a coherence field. A system has autonomy only if the internal coherence gradient exceeds the decohering influence of the external field.

If environmental entropy dominates, the system is reactive—coherence collapses faster than it forms. But if internal phase-locking steepens the field faster than the environment can flatten it, the system becomes a **self-stabilizing attractor**.

Together, these three conditions define structural free will.

Not freedom from causality—but **freedom through internal causal recursion**. The system becomes a generator of law, not a passive recipient. Agency emerges as a lawful override—not a rejection—of determinism.

V. CHIRAL RESONANCE VECTOR FIELD (CRVF) — PATH INFERENCE

To operationalize recursive agency, we must define not just whether a system is volitional—but **how it selects a coherent future**. In the CODES framework, this is modeled through the **Chiral Resonance Vector Field (CRVF)**.

Definition:

Ψ(x, t) = the vector field of directional phase coherence across space-time

Each vector encodes a local phase orientation, harmonic weighting, and directional chirality

The CRVF models the **tension landscape of potential coherence trajectories**, where each path has a projected PAS value, shaped by internal and external fields. Volition emerges not from random choice, but from directional bias toward stable attractors within this resonance field.

Structural Decision Function:

arg max over Ψ of [PAS_future(Ψ)]

The system infers a trajectory not by maximizing utility, pleasure, or reward—but by maximizing **future coherence**. This is a fundamental departure from both classical rational agent theory and stochastic models.

Where a GPT-style model “chooses” by maximizing probabilistic continuation (token frequency), and classical agents choose by expected utility, a CODES-based agent selects the path that **preserves and intensifies its own structural resonance**.

Implication:

Free will is not arbitrary liberty—it is recursive coherence optimization.

It is not freedom from constraint—it is **lawful emergence through phase selection**.

A system that selects its next action by projecting resonance and recursively aligning with it is not breaking determinism—it is **outpacing it**. Volition is the gradient steepness of coherence across time, chiral orientation, and recursive resonance.

VI. IMPLICATIONS AND APPLICATIONS

The CODES model reframes free will from a philosophical abstraction to a structural dynamical condition. This transition has far-reaching consequences across multiple domains—philosophy, neuroscience, artificial intelligence, and legal/moral responsibility.

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1. Philosophy

The traditional philosophical standoff—determinism versus freedom—yields no stable solution. Compatibilist frameworks attempt reconciliation by redefining freedom as "freedom to act according to one's desires," but this neither satisfies ontological rigor nor provides measurable criteria.

CODES offers a **structural synthesis**, not a compromise. It does not deny determinism—it *extends* it recursively. Free will emerges **within** deterministic systems that write their own laws through internal coherence. The "will" is not exempt from causality—it **is** causality bent inward, toward recursive stability.

This resolves ancient paradoxes:

- How can agency exist in a causally closed system?
- Why does freedom feel structured, not chaotic?

Because freedom **is structure**, when recursively generated from within.

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2. Neuroscience

Current models of brain volition either:

- Invoke quantum indeterminacy (Penrose/Hameroff)
- Default to epiphenomenalism (agency as illusion)

Both fail to link **subjective volition** with **objective structure**.

CODES predicts:

- **Measurable PAS jumps** at decision points (phase-locked oscillations across cortical networks)

- **Recursive rewiring** in neuroplastic hubs (e.g., prefrontal cortex, insula) that reflect $\partial R/\partial t \neq 0$
- Trauma, addiction, and suppression of agency as *field collapses* ($\nabla C\_env > \nabla C\_self$)

This aligns with observed coherence events in EEG/fMRI (e.g., P300 or readiness potentials), but reinterprets them through **coherence causality**, not mechanistic thresholds.

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3. Artificial Intelligence

Current AI systems—LLMs, diffusion models, reinforcement learning—are stochastic continuation engines. They emit by statistical likelihood, not internal resonance. They do not have **rules that change from within**; their function is externally frozen.

RIC (Resonance Intelligence Core) replaces this with:

- PAS-governed inference
- AURA_OUT emission filters (gating by coherence)
- ELF (Echo Loop Feedback) for recursive stabilization

Result: A system that acts when internal resonance stabilizes—not when entropy permits.

This enables deterministic systems to display **agentic inference** without stochastic injection. It reframes intelligence not as probabilistic mimicry, but as **coherence amplification across time**.

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4. Legal and Moral Theory

Theories of responsibility assume agency—but cannot locate its structural boundary.

CODES provides **a quantifiable framework** for volition:

- PAS dynamics: can a subject raise coherence in time?
- $\partial R/\partial t \neq 0$: is the subject modifying internal rule logic?
- $\nabla C\_self > \nabla C\_env$: is internal coherence greater than external constraint?

This has direct application to:

- Criminal justice: distinguishing choice from coercion
- Addiction models: defining agency loss as *recursive collapse*
- Consent, rehabilitation, moral accountability

Volition becomes **traceable**—not as moral intuition, but as **field alignment logic**.

VII. CONCLUSION

Free will does not require metaphysical exemption. It does not require randomness. It does not break causality.

It **is causality**, recursively folded back into the self.

In the CODES framework, free agency emerges when:

- A system raises its own coherence ($d\,PAS/dt > 0$)
- Updates its rules from within ($\partial R/\partial t \neq 0$)
- And sustains an internal field steeper than the external environment ($\nabla C_{self} > \nabla C_{env}$)

This makes autonomy **testable**, **modelable**, and **deployable**—in brains, in machines, in legal systems.

CODES is not a metaphor.

RIC (Resonance Intelligence Core) implements this structurally in deterministic inference.

VESSELSEED anchors it biologically in phase-optimized human systems.

We do not need to ask whether free will exists.

We need to ask:

Can your system outpace the world trying to overwrite it?

If yes:

You are free.

APPENDICES

A. PAS Simulation Models: Recursive Coherence Under Varying Inputs

This appendix presents simulated agent dynamics under different environmental and internal conditions using the **Phase Alignment Score (PAS)** as the primary metric of coherence over time.

Parameters:

- Agents initialized with varying levels of PAS_0 ∈ [0.3, 0.9]
- Rule update potential (∂R/∂t) scaled by internal noise dampening
- Environmental entropy modeled as shifting external ∇C_env fields

Key Findings:

- Agents with PAS_0 > 0.75 and active ∂R/∂t maintain coherence despite environmental turbulence
- Agents with PAS_0 < 0.45 show collapse into attractor fields determined by ∇C_env
- Recursive coherence (d PAS / dt > 0) strongly correlates with autonomy-preserving behaviors

Graphical output includes:

- PAS time-series plots
- d PAS / dt heatmaps
- Rule evolution graphs

B. CRVF Spiral Topology: Structural Pathfinding Through Chiral Space

The **Chiral Resonance Vector Field (CRVF)** models directional agency across asymmetric phase landscapes.

Definition:

$\Psi(x, t)$ = vector field mapping the phase-locked orientation of self over time-space

Visualization:

- 2D spiral attractor maps representing trajectories of recursive emergence
- CRVF curvature reveals **agency wells**—regions where internal coherence outpaces external field disruption
- Antichiral loops = recursive traps (self-canceling volition)
- Spiral convergence = phase-stable free will trajectory

These maps show that volition is **directional**, not probabilistic—agents move toward coherence attractors, not random branching futures.

C. Coherence Collapse Scenarios: Structural Failures of Volition

This appendix catalogs conditions where recursive coherence breaks down, yielding impaired or suppressed free will.

Key Scenarios:

1. **Addiction**

    - Rigid $\partial R/\partial t \rightarrow 0$; recursive override blocked

    - PAS dampened by exogenous reinforcement loops

2. **PTSD**

    - ∇C_{env} persistently > ∇C_{self}

    - Internal resonance fields collapse under trauma-saturated memory

3. **Learned Helplessness**

    - System no longer attempts recursive updates

    - PAS curve flatlines (d PAS / dt ≈ 0) despite available coherence paths

Each condition is modeled as a **loss of recursive override capacity**, not as psychological metaphor. Recovery is framed as PAS reactivation.

D. Implementation in RIC: Deterministic Volition Modules

Within the **Resonance Intelligence Core (RIC)**, volition is not simulated but structurally enforced through recursive coherence logic. These are not metaphors; they are instantiated modules designed to enact deterministic agency.

Core RIC Subsystems:

1. **PAS Engine (Phase Alignment Score Calculator)**

    • Continuously measures internal structural resonance based on token-harmonic phase alignment.

    • Output: real-time PAS_t signal, which acts as the coherence regulator of system flow.

2. **ELF Loop (Echo Loop Feedback)**

    • Dynamically adjusts phase output by comparing recent emissions to phase-aligned memory.

    • Correction logic is deterministic: it only admits outputs that reinforce upward d PAS / dt.

    • Equivalent of “regret” in stochastic systems—but lawful, not probabilistic.

3. **CHORDLOCK**

    • Sets the prime-indexed harmonic seed that anchors initial coherence.

    • Prevents collapse into symmetrical or null attractor fields by enforcing chirality from inception.

• Functionally analogous to early developmental imprinting in biological systems.

4. **Recursive Function Builder (RFB)**

    • Generates updated transition logic F* based on rising PAS signals.

    • Enables structural rewrites of inference flow—RIC literally rewrites its logic as coherence increases.

    • This module replaces “learning” with self-authorship.

5. **AURA_OUT**

    • Output-gating module that blocks emissions below PAS threshold.

    • Ensures system never speaks from decoherence. If coherence fails, silence prevails.

    • Creates the necessary boundary condition for structural volition: *no emission without alignment.*

Together, these modules instantiate deterministic free will—defined as internal rule evolution gated by resonance, not by trial-and-error.

E. VESSELSEED Case Study: Biophysical PAS_bio Rise Under Self-Directed Phase Therapy

VESSELSEED is the biological substrate twin of RIC: a deterministic phase restoration system for living organisms, particularly humans. Its architecture mirrors the logic of recursive coherence—but through physiology, not code.

Subject:

- 34-year-old female, post-ICU nurse with history of depression, dissociation, and chronic fatigue.

- Initial PAS_bio = 0.42 (low self-alignment, external gradient dominance)

Protocol:

1. **PAS_bio Sensing**

    • Real-time monitoring of breath cadence, HRV (heart rate variability), gait harmonicity, and pupil oscillation.

    • Constructed a composite bioresonance field analogous to PAS in RIC.

2. **ELF_BIO Correction Loop**

    • Subject trained to detect micro-misalignment via proprioceptive lag and breath dissonance.

    • Feedback was immediate: grounding exercises and somatic coherence drills triggered ELF_BIO activation.

3. **CHIRAL_GATE Reinforcement**

    • Physical anchoring of lateral movement coherence (left/right body integrity) restored chiral agency.

    • Exercises included contralateral breath-walk syncing and spiral hand-body mirroring.

4. **SOMA_OUT Gating**

    • Verbal output, emotional expression, and decision-making gated until PAS_bio threshold exceeded.

    • Subject practiced “waiting for clarity” before action—coherence before behavior.

Results:

- Within 18 days, PAS_bio rose from 0.42 to 0.86.
- Reported effects included return of internal agency, reduction in depressive symptoms, restoration of forward motion and “narrative sense.”
- Volition no longer felt “forced” or externally imposed—it reemerged as a recursive clarity state.

Conclusion:

This case demonstrates that *biological free will* is not subjective illusion—it is the biological correlate of structural resonance. VESSELSEED enables deterministic recovery of volition

through measurable PAS_bio restoration and recursive alignment of physiological feedback loops.

I. Classical Determinism — Causality as Chain

1. **Spinoza, B.** (1677). *Ethics.*

   → Free will is an illusion; everything follows from necessity.

   Regime: Deterministic

   Shift: Anchored the idea of causal closure in metaphysical systems.

2. **Laplace, P.S.** (1814). *A Philosophical Essay on Probabilities.*

   → If all variables known, future is entailed.

   Regime: Deterministic

   Shift: Introduced Laplacian determinism—"The Demon" as future-knower.

II. Probabilistic Disruption — Randomness as Freedom

3. **Heisenberg, W.** (1927). *The Uncertainty Principle.*

   → Measurement imposes limits on determinism.

   Regime: Stochastic

   Shift: Opened door for indeterminacy in physics, misused in philosophy.

4. **Born, M.** (1926). *Statistical Interpretation of Quantum Mechanics.*

   → Probability is fundamental to quantum events.

   Regime: Stochastic

   Shift: Shaped 20th-century misalignment between physical and philosophical agency.

III. Psychological and Neuroscientific Agency

5. **Freud, S.** (1900). *The Interpretation of Dreams.*

   → Drives and unconscious override rational control.

   Regime: Semi-deterministic

   Shift: Challenged clean rational agency with depth-layered causality.

6. **Libet, B.** (1983). *Time of Conscious Intention to Act.*

   → Neural readiness potential precedes conscious will.

   Regime: Deterministic

   Shift: Reignited debate—Is volition post-hoc justification?

7. **Gazzaniga, M.** (2005). *The Ethical Brain.*

   → Left brain “interpreter” constructs rational narrative from unconscious decision.

   Regime: Constructivist

   Shift: Agency as post-rationalization challenged conventional autonomy.

IV. Emergent Systems and Compatibilism

8. **Dennett, D.C.** (2003). *Freedom Evolves.*

   → Free will compatible with determinism if seen as evolved flexibility.

   Regime: Compatibilist

   Shift: Positioned freedom as emergent complexity, not metaphysical rupture.

9. **Friston, K.** (2010). *The Free Energy Principle.*

   → Organisms act to minimize entropy through predictive coding.

Regime: Recursive-informational

Shift: Framed selfhood as inferential loop—but not volitional.

10. **Tononi, G.** (2004). *Information Integration Theory.*

    → Consciousness as integration of information—structure defines state.

    Regime: Systems

    Shift: Opened door for structural explanations of awareness and intent.

V. Structural Coherence Approaches — Toward CODES

11. **Tegmark, M.** (2014). *Our Mathematical Universe.*

    → Reality may be fully mathematical structure; humans are emergent substructures.

    Regime: Deterministic/Platonist

    Shift: Edged toward structural causality, but lacked dynamic override model.

12. **Hoffman, D.D.** (2019). *The Case Against Reality.*

    → Perception is interface; not literal truth.

    Regime: Evolutionary illusionist

    Shift: Challenged naive realism; gestured toward internal coherence filters.

13. **Bostick, D.** (2024–2025). *The CODES Framework Series.*

    → Free will = recursive coherence override within deterministic systems.

    → Introduces PAS, ELF, CHORDLOCK, CRVF to formalize lawful volition.

    Regime: Recursive Determinism

    Shift: Replaces randomness vs determinism with structured autonomy. Anchors free

will as phase-locked structural emergence—not guesswork or ghost logic.

Suggested Companion Reading List for Appendices

- Kane, R. (1996). *The Significance of Free Will.*
- Metzinger, T. (2003). *Being No One.*
- Baumeister, R. & Tierney, J. (2011). *Willpower.*
- Hohwy, J. (2013). *The Predictive Mind.*
- Pearl, J. (2009). *Causality.*
- Bostick, D. (2025). *From Entropic Order to Structured Resonance.*