

Interferential Ontology of Probability: Toward a Phase-Based Model of Semantic Realization

Ichiro Fujimori

Independent Researcher

ORCID: <https://orcid.org/0009-0000-8659-0256>

Acknowledgments: Present

Abstract

This paper introduces the Interferential Ontology of Probability, a novel framework that reconceptualizes existence as the result of semantic interference among coexistent interpretive states. By defining presence not as a static outcome but as a modulated intensity derived from phase-based relations among ontological possibilities, the theory provides a unified model that bridges probability theory, ontology, and cognition. Drawing inspiration from quantum mechanics while remaining distinct from physical models, it explains how presence is amplified or diminished through constructive or destructive interference of meaning-bearing states. The formulation extends and operationalizes ideas from Kant, Heidegger, and Whitehead through a mathematically structured approach to semantic coherence. The framework offers significant implications for domains such as AI, extended reality, medical diagnostics, and belief revision—providing a generative mechanism to model non-realization, ambiguity, and observer-relative coherence. The theory's methodological core lies in a complex wave function whose squared modulus yields Existential Intensity. This phase-structured ontology opens new directions in post-classical metaphysics and semantic modeling.

Keywords

ontology, probability, interference, phase, cognition, emergence

1. Introduction

The Interferential Ontology of Probability introduces a novel framework in which the manifestation of existence is not governed by classical additive probabilities, but by wave-like interference among multiple coexistent semantic possibilities. Drawing from the mathematical foundations of quantum mechanics while operating in a non-physical, ontological domain, this theory models presence as a dynamically modulated phenomenon that emerges from the interaction of interpretive and cognitive phase relationships.

Rather than viewing existence as binary—either present or absent—this framework defines it as a continuous variable called Existential Intensity, modulated by the interference of interpretive states. This modulation is captured mathematically through a construct termed the Real-Image Wave Function, $\Psi(x, t)$ ¹, which represents the subjective configuration of reality at spatial coordinate x and temporal coordinate t . The amplitude of this wave function embodies the weighted combination of existential hypotheses, each associated with a particular belief intensity and interpretive phase.

This formulation does not merely describe belief strength; it captures the structural interaction among competing interpretations or perceptual states. What becomes ontologically “real” in a given moment is the result of a phase-based synthesis of potential semantic components, not an isolated observation. In this respect, the framework extends Kantian transcendental idealism, Heideggerian disclosedness, and Whiteheadian process ontology² by mathematically modeling how interpretive engagement constructs the world.

By introducing phase interference into the ontology of probability, this theory challenges classical notions of objectivity and linear causation. Instead, it proposes that existence is shaped by observer-relative semantic interference—a superpositional dynamic that gives rise to probabilistic but coherent structure. This paper presents the formal structure of the theory, its philosophical context, and its applications to both human cognition and emerging technologies such as large language models and XR-based presence detection systems.

Importantly, while inspired by prior traditions, this theory does not merely iterate existing ideas; it formally encodes how presence can be mathematically generated, attenuated, or erased by semantic structure. In this sense, it may be regarded as a significant reconceptualization of ontological emergence—enabling ontological analysis to be extended to computational and interpretive systems without relying on physicalist metaphors or deterministic schemas.

2. Mathematical Formulation

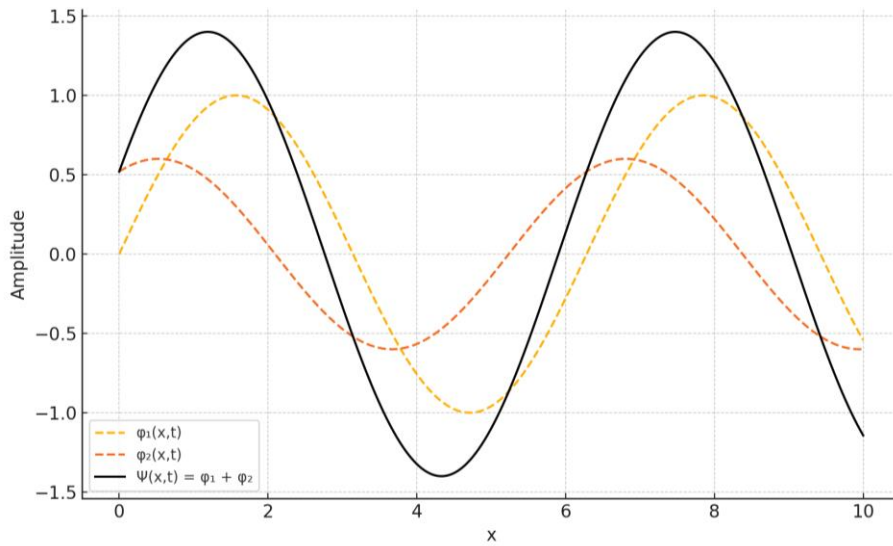


Figure 1. Structural Composition of the Real-Image Wave Function $\Psi(x, t)$

This figure illustrates how the Real-Image Wave Function is formed by the weighted superposition of ontological components $\phi_i(x, t)$, each modulated by a phase-based interference coefficient $c_i(t) = r_i \cdot e^{i\theta_i}$ ³. The composition models a non-classical ontology where existence is not merely additive, but shaped through complex interference between interpretive potentials.

The core of this theory is the Real-Image Wave Function, $\Psi(x, t)$, which represents the ontological configuration of potential realities. It is defined as:

$$\Psi(x, t) = \sum_i [c_i(t) \cdot \phi_i(x, t)]$$

Where:

- $\varphi_i(x, t)$ is the i -th ontological basis element (a possible existential state).
- $c_i(t) = r_i(t) \cdot e^{i\theta_i(t)}$ is the Phase-Based Interference Coefficient, composed of:
 - $r_i(t)$: real-valued existential focus intensity
 - $\theta_i(t)$: cognitive phase angle expressing semantic alignment

The Existential Intensity, $P(x, t)$, which quantifies the degree to which something exists at point (x, t) , is defined as the squared modulus of the wave function:

$$P(x, t) = |\Psi(x, t)|^2$$

$$= \left| \sum_i [r_i(t) \cdot e^{i\theta_i(t)} \cdot \varphi_i(x, t)] \right|^2$$

Expanding this yields:

$$P(x, t) = \sum_i r_i^2 \cdot |\varphi_i(x, t)|^2 + \sum_{\{i \neq j\}} 2 \cdot r_i \cdot r_j \cdot |\varphi_i(x, t)| \cdot |\varphi_j(x, t)| \cdot \cos(\theta_i - \theta_j + \delta)$$

The first term represents the independent contribution of each ontological basis element. The second term is the interference term, which reflects how differences in interpretive phase $(\theta_i - \theta_j)$, modulated by context-sensitive offset δ , either amplify or diminish the existential intensity $P(x, t)$.

3. Structural Interpretation

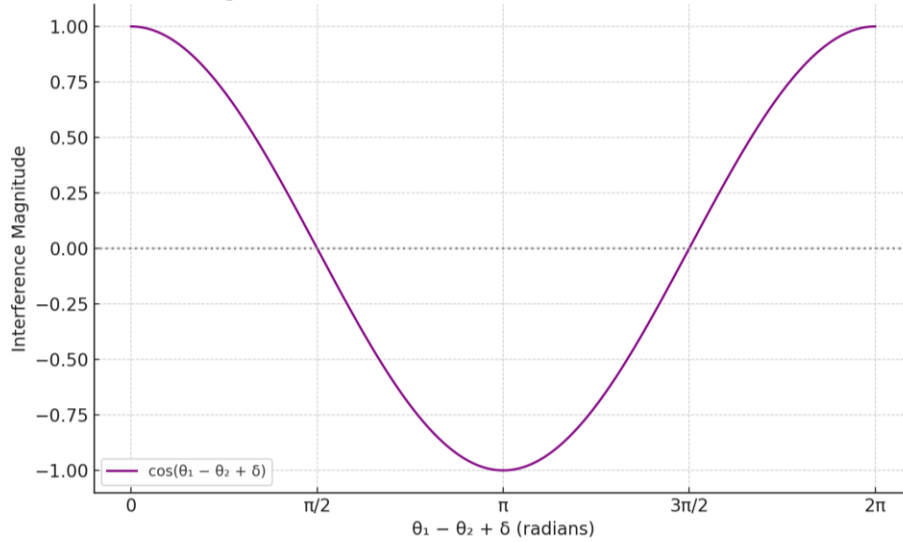


Figure 2. Phase-Dependent Variation in Existential Intensity $P(x, t)$

This figure shows how the existential intensity $P(x, t)$ varies as a function of the phase difference $(\theta_1 - \theta_2)$ between two ontological components. The resulting interference follows a cosine curve, where maximal presence arises at phase coherence and minimal presence (or cancellation) arises at phase opposition. This illustrates the mathematical mechanism underlying semantic modulation in the interferential framework.

In the Interferential Ontology of Probability, each ontological basis component $\varphi_i(x, t)$ represents a semantically distinct, cognitively accessible possible state of existence. These components are not merely abstract labels but function as structurally significant vectors in an ontological configuration space. They encode specific world-descriptions, perceptions, beliefs, or hypotheses, all of which contribute to the observer's total phenomenological state.

The Real-Image Wave Function

$$\Psi(x, t) = \sum_i [c_i(t) \cdot \varphi_i(x, t)]$$

thus expresses the composite of what the observer is simultaneously attending to, believing in, or conceptually holding. Its amplitude is determined by both the attention-weight r_i and the phase-angle θ_i associated with each φ_i . These phase angles are not

random—they arise from interpretive history, semantic orientation, emotional state, and context-driven expectation. As such, they reflect the semantic vector alignment of each component with the observer's current interpretive frame.

The interference term in the squared modulus of the wave function:

$$P(x, t) = \sum_i r_i^2 \cdot |\varphi_i(x, t)|^2 + \sum_{\{i \neq j\}} 2 \cdot r_i \cdot r_j \cdot |\varphi_i(x, t)| \cdot |\varphi_j(x, t)| \cdot \cos(\theta_i - \theta_j + \delta)$$

is central to the theory's structural interpretation. It reveals how ontological contributions are not simply added together, but modulated based on phase coherence or dissonance. A high r_j may still contribute little to $P(x, t)$ if its phase θ_j is misaligned with other components, leading to destructive interference. Conversely, even relatively low-intensity components may amplify existential intensity when their phases are coherent.

This allows for the modeling of constructive dissolution—a semantic attenuation mechanism where certain possibilities cancel each other out not because they are logically contradictory, but because their phase relationships are incompatible. Such interactions can lead to decreased presence despite high base probabilities, a phenomenon classical probabilistic ontology cannot account for.

By interpreting $\varphi_i(x, t)$ as ontological semiotic agents, the theory integrates cognitive interference, interpretive structure, and probabilistic modulation into a unified explanatory system. The observer, through selective attention and phase generation, acts not merely as a passive receiver but as an active semantic modulator⁴, determining the very structure of what appears to exist.

4. Annihilation and the Non-Realization of Existence

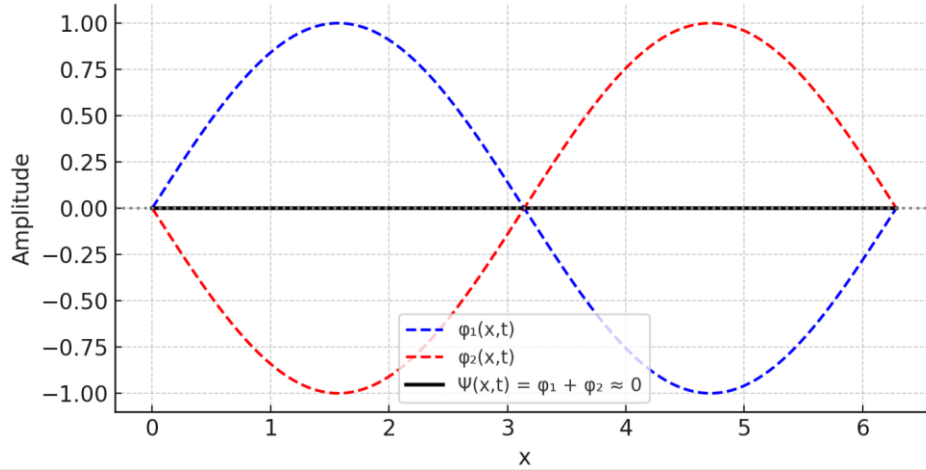


Figure 3. Interference-Driven Presence Determination across Competing ϕ_i

Visualizing the interaction between multiple $\phi_i(x, t)$, this figure shows how phase alignment among interpretive components determines the realized intensity of existence. Misaligned phases result in annihilation⁵, while coherent configurations reinforce presence. The model formalizes how semantic interpretation dynamically constructs or erases existential states.

Within the Interferential Ontology of Probability, the non-emergence of presence is not merely the absence of observation or insufficient belief, but a structurally definable phenomenon arising from interference itself. Existence fails to realize not because $\phi_i(x, t)$ is weak in isolation, but because its coexistence with other $\phi_j(x, t)$ leads to phase-incompatible cancellation. This phenomenon is referred to as ontological annihilation.

Recall the expression for existential intensity:

$$\begin{aligned}
 P(x, t) &= |\Psi(x, t)|^2 \\
 &= \left| \sum_i [r_i(t) \cdot e^{i\theta_i(t)} \cdot \phi_i(x, t)] \right|^2 \\
 &= \sum_i r_i^2 \cdot |\phi_i(x, t)|^2 + \sum_{i \neq j} 2 \cdot r_i \cdot r_j \cdot |\phi_i(x, t)| \cdot |\phi_j(x, t)| \cdot \cos(\theta_i - \theta_j + \delta)
 \end{aligned}$$

Even when the first term is large—that is, even when the observer is heavily invested in certain ϕ_i —the second term can become dominantly negative. This results in $P(x, t)$

approaching zero despite the presence of strong existential commitments. It is not disbelief, but destructive interference that erases manifestation.

This has significant ontological consequences: something can “exist” in potentiality (have high r_i and $|\phi_i|$), yet still be non-realized due to misaligned phase structure. Such annihilation is not passive absence but active cancellation—a structural negation of reality.

Examples include:

- Suppressed perceptual content: In attention, competing stimuli may destructively interfere, rendering neither consciously perceptible.
- Unacted intentions: Strong, conflicting motivations ϕ_1 and ϕ_2 may cancel through internal phase opposition, leading to existential paralysis.
- Unrealized possibilities: In sociocultural or technological contexts, mutually exclusive futures may cancel one another within the interpretive field, reducing their combined ontic weight.

From a formal perspective, non-realization occurs when:

$$\cos(\theta_i - \theta_j + \delta) \approx -1$$

repeatedly dominates across ϕ_i - ϕ_j pairs. In such cases, $P(x, t) \approx 0$, and thus the world fails to present that possibility—even when its components are cognitively present.

This model therefore defines annihilation not as elimination, but as a phase-structured erasure. What does not appear is not simply hidden—it is canceled.

5. Applications and Implications

The Interferential Ontology of Probability is not merely a metaphysical abstraction—it offers a rigorous, extensible framework for analyzing systems in which multiple competing interpretations interact to modulate perceived or realized presence.

This theory can be applied in a wide range of philosophical and technological domains, including:

- Large Language Models (LLMs):
Misaligned or hallucinated outputs can be interpreted as the result of semantic phase incoherence among competing internal states φ_i . When multiple completions interfere destructively, $P(x, t)$ drops, yielding nonsensical or incoherent responses despite locally valid components.
- Extended Reality (XR) and presence modulation:
Presence in immersive virtual environments depends not only on sensory fidelity but on the coherence of interpretive components. The theory explains how disrupted or phase-incoherent narrative or interactional structures result in reduced felt reality.
- Medical diagnosis and cognitive dissonance:
The interference of conflicting diagnostic indicators, each φ_i with different r_i and θ_i , may reduce the overall perceived certainty (P). This framework models how ambiguous findings interact semantically to yield diagnostic hesitation or error.
- Predictive control systems in AI and robotics:
Decision systems can be enhanced by incorporating phase-aware aggregation of state evaluations. Instead of treating multiple condition evaluations as additive, interference-aware combination allows for prioritization of coherent interpretations.
- Philosophy of mind and belief revision:
Apparent contradiction or belief change can be modeled not as replacement but as phase transition between interpretive vectors. Cognitive shifts thus occur through θ_i realignment rather than hard deletion of φ_i components.

What unites these applications is the idea that presence, realization, and decision emerge not from additive summation but from the phase-structured dynamics of interference. This theory thereby offers a new class of analytical tools for understanding semantically complex, observer-dependent systems—blending epistemology, ontology, and systems theory.

Conclusion

This paper has introduced the Interferential Ontology of Probability as a novel framework for describing how existence itself emerges through the phase-structured interaction of possible realities. By defining presence not as a binary or additive probability, but as an amplitude modulated by semantic interference, the theory offers a unifying structure that bridges ontology, cognition, and information systems.

It reconceptualizes traditional metaphysical questions in formal terms, enabling rigorous treatment of interpretive conflict, ambiguity, and non-realization. Unlike classical probability theories that treat potentialities as scalar quantities, this framework encodes their semantic orientation, phase interaction, and observer-relative coherence.

As such, it extends the ontological commitments of Kantian idealism, Heideggerian clearing, and Whiteheadian process, while remaining adaptable to practical domains including AI, XR, medicine, and human decision-making. It opens a path for future studies that integrate probabilistic logic with cognitive architecture and semantic dynamics.

In doing so, the Interferential Ontology of Probability offers not only a theoretical contribution but a methodological toolkit—one that may support the construction of next-generation ontological models grounded in interference, modulation, and presence.

Acknowledgments

The author gratefully acknowledges the conceptual legacies of Kant, Heidegger, and Whitehead, whose philosophical architectures provided essential grounding for this work. This study was shaped in dialogue with both enduring metaphysical traditions and the emerging contours of technological thought. Silent appreciation is also extended to all who dwell at the boundary of established understanding—where new forms of intelligibility begin to take shape beneath the surface of inherited language.

Footnotes

1. The mathematical structure of $\Psi(x, t)$ is inspired by quantum wave functions but is interpreted ontologically, not physically.
2. This framework draws on Kant, Heidegger, and Whitehead, but operationalizes their ideas using formal probabilistic constructs.
3. The use of complex coefficients $c_i(t)$ enables semantic phase representation that traditional real-valued probability theory cannot accommodate.
4. The observer is not a passive recipient but an active modulator of existential configuration via r_i and θ_i parameters.
5. The term “annihilation” refers to ontological cancellation through interference, not to material destruction.

Glossary

- Real-Image Wave Function ($\Psi(x, t)$): A subjective wave function encoding the superposition of coexistent semantic interpretations at location x and time t .
- Existential Intensity ($P(x, t)$): The modulated degree to which a possibility exists or is realized at (x, t) , computed as $|\Psi|^2$.
- Ontological Basis Component (φ_i): A semantically distinct potential state of reality contributing to the total configuration.
- Phase-Based Interference Coefficient (c_i): The complex-valued amplitude assigned to φ_i , composed of r_i and θ_i .
- Cognitive Phase (θ_i): The interpretive or semantic orientation of a potential state, governing its interference behavior.
- Semantic Offset (δ): A context-sensitive adjustment term modulating relative phase interference among basis components.

References

1. Bohr, N. (1934). Atomic Theory and the Description of Nature.
2. Heidegger, M. (1927). Being and Time.

3. Kant, I. (1781). Critique of Pure Reason.
4. Whitehead, A. N. (1929). Process and Reality.
5. Varela, F. J., Thompson, E., & Rosch, E. (1991). The Embodied Mind.
6. Busemeyer, J. R., & Bruza, P. D. (2012). Quantum Models of Cognition and Decision.
7. McFarlane, S., & Danks, D. (2021). Interference-based Semantics for Conflicting Beliefs.
8. Floridi, L. (2011). The Philosophy of Information.
9. Chalmers, D. J. (1996). The Conscious Mind: In Search of a Fundamental Theory.
10. Friston, K. (2010). The Free-Energy Principle: A Unified Brain Theory?