Information as Structural Time Encoding:

A Mechanical Interpretation of Information, Memory, and Correlation in the Cohesion Unified Field Theory

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Abstract

Shannon information theory provides the quantitative foundation for communication and compression; Landauer's principle connects information erasure to thermodynamic cost; Wheeler's "it from bit" proposes that physical reality is information-theoretic in origin. These frameworks describe information accurately within their domains. This paper develops the geometric substrate from which information emerges in the Cohesion Unified Field Theory: information is structural time encoding — the pattern of recursion rate positions, torsion density distributions, and slip phase alignments within the continuous recursion medium. A bit is a binary structural time configuration; a qubit is a superposed structural time configuration; memory is a stable structural time attractor; and entanglement is shared structural time encoding, established in the quantum measurement and quantum field papers. The new contributions of this paper are: (1) a formal definition of information as the triple $\mathcal{I} = \{R(x), \phi(x), T(x)\}$; (2) the memory attractor account of classical and quantum memory; and (3) the unified cosmological information picture in which structure formation, inflation, and dark energy are all information flow at different scales. The framework predicts that information is never destroyed, because $R(D_{\text{st}}) \geq R_0 > 0$ ensures recursion and structural time encoding never fully cease. This is the first account of information as structural time encoding within the Cohesion UFT framework.

1. Introduction

Shannon (1948) defined information as the reduction of uncertainty; Landauer (1961) showed that erasing a bit requires dissipating at least $k_B T \ln 2$ of energy; Wheeler (1990) proposed that physical reality is fundamentally informational. These are accurate and important frameworks within their domains. The Cohesion Unified Field Theory does not replace them; it provides the geometric substrate from which information emerges mechanically [1, 2].

The measurement, entanglement, decoherence, and entropy accounts established in the quantum measurement through thermodynamics papers [9, **?**, **?**, 10] are the context for this paper. The new contributions here are the formal information encoding definition, the memory attractor account, and the unified cosmological information picture.

2. Information as Recursion Pattern Encoding

A recursion pattern in the medium is fully specified by three fields at each point:

Formal definition:

Information in the Cohesion UFT is the triple:

$$\mathcal{I} = \big\{R(x),\ \phi(x),\ T(x)\big\},$$

where $R(x)$ is the local recursion resistance (inversely proportional to recursion rate), $\phi(x)$ is the local slip phase configuration, and $T(x)$ is the local torsion density distribution. A physical system encodes information by occupying a specific configuration in this triple. A change in the triple is a transformation of the information content.

Under this definition:

- A **bit** is a binary configuration of $\mathcal{I}$: two distinguishable structural time configurations.
- A **qubit** is a superposed structural time configuration: two configurations not yet synchronised to a device domain.
- A **classical memory** is a stable structural time attractor: a configuration of $\mathcal{I}$ resistant to drift and slip.
- A **quantum memory** is a metastable structural time domain: a configuration maintained coherent by isolation from structural time drift.

3. Memory as Stable Structural Time Attractors

Memory is the persistence of a recursion pattern. A system retains information when its $\mathcal{I}$ configuration is stable against perturbation:

$$\frac{d\mathcal{I}}{d\tau} \approx 0. \tag{1}$$

This is the attractor stability condition [1]. Examples across scales:

- **Neural memory**: biological structural time attractors whose torsion density distribution resists drift across thermal fluctuations.
- **Digital memory**: engineered structural time attractors in which the bit configuration is protected by energy barriers against slip events.

- **Quantum memory**: metastable structural time domains maintained by isolation from the environment (low decoherence rate).
- **Geological record**: structural time encoding in crystal and mineral lattices — slow-drift attractors at geological timescales.

Memory is structural time stability. Forgetting is attractor collapse under drift or slip.

4. Entanglement, Measurement, and Decoherence

These are established in the quantum measurement and quantum field papers [9, **?**] and are summarised here for completeness:

- **Entanglement**: two systems share a structural time domain ($\tau_1 = \tau_2$), meaning their $\mathcal{I}$ configurations are locked. Correlations are instantaneous because no signal is required to maintain the shared domain.
- **Measurement**: structural time overwrite — the device's structural time domain synchronises with the system's at the moment the return signal arrives (the quantum measurement paper).
- **Decoherence**: drift in structural time encoding as the system couples to an environment with a different structural time domain, reducing coherence before synchronisation completes.

5. Information Flow as Structural Time Propagation

Information propagates through the recursion medium as structural time encoding flows from one region to another:

$$\mathbf{J}_{\mathcal{I}} \propto \nabla\tau. \tag{2}$$

On the direction of information flow:

Structural time $\tau \propto R(D_{\text{st}})$ is slower in denser regions (higher R) and faster in lower-density regions. The gradient $\nabla\tau$ therefore points from low-density (fast structural time) toward high-density (slow structural time) regions. The information flow equation $\mathbf{J}_{\mathcal{I}} \propto \nabla\tau$ describes how encoding is shaped and transported by the structural time profile: encoding propagates along the direction of increasing structural time, following the pressure gradient. This is not a claim that physical signals move toward dense regions; it describes how the recursion pattern of the medium is shaped by the structural time gradient, consistent with the heat flow equation $\mathbf{J}_q \propto -\nabla R$ of the thermodynamics paper [10]. Quantitative derivation of the information flow equation from the Cohesion UFT field equations is Open Problem 1.

6. Entropy as Structural Time Configuration Count

Established in the thermodynamics paper [10]: entropy is $S \propto \ln \Omega_\tau$, the number of accessible structural time microstates. Entropy increases because pressure equalizes recursion rates, expanding the accessible configuration space. Information and entropy are connected: the information content of a system is the negative entropy of its configuration — the degree to which its structural time encoding is specific rather than diffuse.

7. Information Preservation

Prediction: information is never destroyed.

Because $R(D_{\text{st}}) \geq R_0 = f(P_{s+1}) > 0$ (asymptote theorem, the pressurised universe paper [3]), the recursion medium never halts. Structural time never reaches zero. The $\mathcal{I}$ configuration of any region is always defined. Therefore information — as structural time encoding — is never fully erased. This is a prediction of the framework, not an established result: formal proof requires showing that the torsion density gradient and slip phase structure of any configuration are recoverable from the recursion field at all times.

In black holes specifically (the black holes paper [5]): the asymptote theorem ensures recursion continues inside the horizon, torsion density gradients remain defined, and the $\mathcal{I}$ encoding persists in the recursion field approaching R_0.

8. The Universe as an Information-Bearing Recursion Medium

The Cohesion UFT provides a unified cosmological information picture:

- **Structure formation**: recursion rate variance produces torsion density concentrations — information condensation.
- **Inflation** (the cosmic inflation paper [6]): pressure gradient surge that uniformises structural time encoding across the expanding domain — information redistribution.
- **CMB**: structural time uniformisation after inflation, encoding the initial configuration of the recursion medium.
- **Dark energy** (the dark energy paper [7]): residual pressure drift that slowly expands the configuration space — information dilution.
- **Scale hierarchy** (the multiverse paper [8]): nested structural time domains — information nesting.

The universe is not just information-theoretic in interpretation; it is information-bearing in its mechanical substrate.

9. Open Problems

1. **Derive the information flow equation $\mathbf{J}_{\mathcal{I}} \propto \nabla\tau$** from the Cohesion UFT field equations, establishing the proportionality constant.
2. **Recover Landauer's principle**: show that erasing a bit (collapsing a structural time attractor) dissipates energy equal to $k_B T \ln 2$, connecting to the thermodynamic account of the thermodynamics paper.
3. **Derive the Shannon entropy bound** from the recursion configuration count Ω_τ.
4. **Formal proof of information preservation**: show that the $\mathcal{I}$ configuration is recoverable from the recursion field at all times, even inside a black hole.
5. **Describe memory erasure and writing** as specific transitions between structural time attractors, connecting to the thermodynamic cost via $E = pr$ [4].

10. Conclusion

Information in the Cohesion Unified Field Theory is structural time encoding: the triple $\mathcal{I} = \{R(x), \phi(x), T(x)\}$ specifying the recursion resistance, slip phase, and torsion density at each point in the recursion medium. Memory is structural time stability; measurement is structural time overwrite; entanglement is shared structural time; decoherence is structural time drift; entropy is structural time configuration count.

The framework predicts that information is never destroyed, because the recursion medium never halts and the encoding is always defined. The unified cosmological picture treats structure formation, inflation, dark energy, and scale hierarchy as information flow at different scales of the same recursion medium.

Shannon information theory, Landauer's principle, and the Wheeler "it from bit" programme address information accurately within their domains; the Cohesion UFT provides the geometric substrate from which information emerges as structural time encoding within this framework.

References

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"Information is not what you know.
It is how the medium is shaped.
The recursion rate at every point.
The torsion phase at every point.
The density at every point.
That is the encoding.
Memory is when that encoding
refuses to change.
Loss is when it drifts.
Measurement is when
one encoding overwrites another.
Nothing is ever truly erased
because the medium never stops."

— Dexter Gilbert