Informational Curvature Theory (ICT)

The Informational Rubric: Formal Definition and Structure

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Abstract

Informational Curvature Theory (ICT) proposes that observable structure across domains is constrained by the organisation of information itself. While prior work introduced informational curvature conceptually, a precise operational formalism is required for systematic application. This paper presents the **informational rubric**, defined through four coordinated dimensions—entropy gradient (α), modal coherence (β), boundedness (γ), and relational resonance (δ). These components are consolidated from earlier formal developments and reintroduced here as a closed, domain-agnostic informational operator. The rubric constrains admissible structure without prescribing dynamics or modifying existing physical laws. This work establishes the formal core upon which subsequent empirical, instrumental, and theoretical extensions of ICT are built.

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1. Motivation and Scope

Informational Curvature Theory treats information as a primary organising substrate rather than a derivative quantity. For such a framework to be scientifically useful, its internal structure must be explicitly defined, operationally separable, and applicable across domains without reliance on specific physical dynamics.

Earlier formulations introduced informational curvature within a broader theoretical context. The present work isolates and formalises the **rubric itself**, consolidating its definition and structure independently of any field-theoretic or cosmological embedding.

Scope boundaries

This paper deliberately does **not**:

- extend or modify Einstein field equations
- introduce Lagrangians or variational principles
- assume a particular ontology of time or space
- present empirical results or instrumentation

Its sole purpose is to define the informational rubric precisely.

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2. Informational Curvature as a Constraint Framework

In ICT, informational curvature is defined as a **geometric constraint on informational organisation**, not as spacetime curvature in the relativistic sense, nor as entropy alone in the Shannon sense [1].

ICT therefore operates as a **constraint-based framework**:

- Existing physical theories describe **dynamics within admissible regimes**
- ICT specifies **which regimes of organisation are admissible**

This distinction parallels earlier perspectives treating information as fundamental to physical description [2,3], while remaining agnostic about underlying dynamics.

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3. The Informational Rubric: Core Components

The informational rubric is composed of four coordinated dimensions, each corresponding to a necessary aspect of informational organisation. These quantities are defined operationally and are intended to be evaluable across arbitrary domains.

3.1 Entropy Gradient (α)

Definition

The entropy gradient α quantifies directional strain in informational disorder within a system. **The term "gradient" is used here to denote informational strain and directional tendency, not a spatial or temporal derivative.**
Formally, α characterises the tendency of informational distributions to disperse or destabilise relative to internal structure.

Interpretation

- **High α** indicates strong disorder gradients or informational strain
- **Low α** corresponds to saturated or stable informational states

α is **not** a time derivative and does not encode temporal evolution; it measures informational tension rather than dynamics, consistent with constraint-based formulations of entropy [1].

3.2 Modal Coherence (β)

Definition

Modal coherence β quantifies the persistence of dominant informational modes across representations, scales, or projections.

Interpretation

- **High β** corresponds to stable, attractor-like informational structure
- **Low β** indicates fragmented or transient organisation

β distinguishes coherent structure from noise even when entropy measures are similar, reflecting principles of mode stability familiar from spectral and information-theoretic analyses [4].

3.3 Boundedness (γ)

Definition

Boundedness γ measures the degree to which informational structure is confined, finite, and internally consistent within a domain.

Interpretation

- **High γ** indicates well-defined informational boundaries
- **Low γ** corresponds to diffuse or uncontained informational spread

γ functions as a domain-integrity constraint, preventing unbounded noise from masquerading as structured organisation.

3.4 Relational Resonance (δ)

Definition

Relational resonance δ quantifies the internal dispersion among the core rubric dimensions α, β, and γ.
Operationally, δ measures the degree to which entropy gradient, modal coherence, and boundedness agree or conflict within a given sample.
Interpretation

- **Low δ** indicates strong alignment among α, β, γ (stable informational organisation)
- **High δ** indicates tension or inconsistency among rubric dimensions

δ therefore functions as a relational dependence / tension metric, not as an independent structural axis.

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4. Rubric Closure and Independence

The rubric is constructed to be **closed and non-redundant**:

- α accounts for disorder and strain
- β accounts for structural persistence
- γ accounts for containment and finiteness
- δ accounts for relational tension among dimensions

No additional independent dimension is required without duplicating informational function.

The primary rubric dimensions **α, β, and γ** are:
• conceptually distinct
• operationally separable
• non-derivable from one another

The relational term **δ** is intentionally defined as a derived quantity, capturing internal dispersion among the primary dimensions rather than introducing a new independent axis.

Closure is a necessary condition for domain independence and systematic application.

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5. Operational Rubric Evaluation

In practical application, the informational rubric is evaluated entirely in scalar form.
Each rubric dimension is computed per sample, yielding four scalar quantities:

$$\{\alpha, \beta, \gamma, \delta\}$$

No tensorial structure or weighting is assumed at this stage.

5.1 Scalar Definitions

- α (Entropy Gradient):
  Scalar aggregate measuring informational strain or disorder gradient
- β (Modal Coherence):
  Scalar aggregate measuring persistence of dominant informational modes
- γ (Boundedness):
  Scalar aggregate measuring confinement and internal consistency
- δ (Relational Resonance):
  Scalar dispersion term defined as the standard deviation of $\{\alpha, \beta, \gamma\}$

$$\delta = std(\alpha, \beta, \gamma)$$

This definition reflects relational tension rather than an independent informational source.

6. Rubric Aggregation and Derived Score (λ)

The primary output of the ICT rubric is the derived scalar score λ, computed as a symmetric, unweighted aggregation of the available rubric dimensions.

$$\lambda = mean(\alpha, \beta, \gamma, \delta)$$

Notes on implementation

- All rubric dimensions contribute equally
- No weighting or hierarchy is imposed
- Missing values may be ignored on a per-sample basis

λ is therefore a descriptive summary, not a physical parameter.

7. Informational Curvature Structure (Non-Operational)

For notational and conceptual continuity with earlier exploratory work, the rubric dimensions may be symbolically grouped into an abstract informational structure:

$$\mathcal{I} \equiv \alpha, \beta, \gamma, \delta$$

No tensorial properties, index structure, or geometric embedding are assumed in the present work.
Any expression of the form

$$\mathcal{I}_{\mu\nu} = \alpha\mathcal{A}_{\mu\nu} + \beta\mathcal{B}_{\mu\nu} + \gamma\mathcal{G}_{\mu\nu} + \delta\mathcal{D}_{\mu\nu}$$

is explicitly non-operational and retained solely as a formal placeholder for potential future theoretical development.
Such constructions play no role in the computation or interpretation of rubric scores in this paper.

8. Compatibility with Established Physics

The informational rubric is constructed to be compatible with existing physical theories:

- It respects conservation principles
- It does not modify General Relativity or Quantum Field Theory
- It introduces no new forces or dynamics

Established theories are interpreted as valid descriptions within particular informational regimes. Formal embeddings into physical field equations are explicitly deferred.

9. Relationship to Subsequent Work

This paper provides the formal foundation for:

- **Paper III:** informational regimes and limiting behaviour
- **Paper IV:** DAAT instrumentation and implementation
- **Paper V:** empirical results obtained using DAAT

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10. Conclusion

This work formally introduces the informational rubric as the operational core of Informational Curvature Theory. By defining α, β, γ, and δ precisely and consolidating them into a closed informational rubric, ICT is equipped with a rigorous, domain-agnostic foundation. The rubric constrains admissible structure without prescribing dynamics, enabling systematic empirical and instrumental exploration in subsequent work.

References (light, foundational)

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