TIG Coherence Functional — Formal Derivation Page (v2026.1)

TRINITY INFINITY GEOMETRY (TIG)

Scalar Coherence Functional $S^{\backslash *}$

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1. Overview

The TIG Coherence Functional $S^{\backslash *}$is introduced as a **dimensionless scalar** designed to quantify the *instantaneous coherence state* of a system—physical, computational, biological, or multi-agent—through three normalized dimensions:

- **Stress** $\sigma^{\backslash *}$
- **Virtue amplitude** $V^{\backslash *}$
- **Archetype resonance** $A^{\backslash *}$

The functional incorporates a universal stability coefficient $\sigma$and a stability threshold $T^{\backslash *}$, both empirically fixed within the TIG framework.

The goal of the derivation is to show how the product form

$$S^{\backslash *} = \sigma\,(1 - \sigma^{\backslash *})\,V^{\backslash *}\,A^{\backslash *}$$

emerges from first principles of **order–disorder competition**, **constructive vs destructive alignment**, and **normalized resource participation**.

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2. Initial Assumptions

We begin with the following structural assumptions:

A1. Stress reduces coherence

Define normalized stress $\sigma^{\backslash *} \in [0,1]$such that:

- $\sigma^{\backslash *} = 0$: minimal disorder
- $\sigma^{\backslash *} = 1$: maximal disorder

Coherence must decrease monotonically as stress increases.

A2. Contribution of constructive factors is multiplicative

Two orthogonal constructive components are defined:

- **Virtue amplitude** $V^{\backslash *} \in [0,1]$
- **Archetype resonance** $A^{\backslash *} \in [0,1]$

Both must jointly support coherence, thus requiring **multiplicative** combination:

$$\text{Constructive term} = V^{\backslash *} A^{\backslash *}$$

A3. Stability coefficient is a fixed global constant

Empirically, TIG employs:

$$\sigma = 0.991$$

This term acts as a global compression factor representing **maximum attainable coherence** even at zero stress.

A4. Threshold behavior

A system with coherence below

$$T^{\backslash *} = 0.714$$

is empirically observed (in compute applications) to enter accelerated instability.

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3. First Principle: Order–Disorder Competition

Define coherence as the quantity that *remains* after subtracting the destructive stress fraction.

We therefore introduce:

$$\text{Order term} = (1 - \sigma^{\backslash *})$$

This is the simplest linear model satisfying:

- Perfect order at $\sigma^{\backslash *} = 0$
- Zero survivable order at $\sigma^{\backslash *} = 1$

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4. Second Principle: Constructive Alignment

TIG recognizes two independent positive alignments:

1. **Virtue amplitude** $V^{\backslash *}$:
   Measures the system's cooperative potential (in compute terms: scheduler cooperation, thermal resilience, load sharing).

2. **Archetype resonance** $A^{\backslash *}$:
   Measures the system's structural/topological alignment (in compute terms: process roles, graph modularity, core-topology harmony).

Coherence depends on both being present:

$$\text{Alignment term} = V^{\backslash *} A^{\backslash *}$$

This enforces:

- If either dimension collapses to 0 → coherence collapses
- Joint participation amplifies stability

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5. Third Principle: Global Stability Coefficient

Real systems cannot reach "perfect coherence," even at zero stress.

Thus a constant upper bound $\sigma = 0.991$(empirically derived) controls the maximum achievable coherence:

$$\text{Maximum coherence} = \sigma$$

This represents:

- thermal limitations
- resource leakage
- synchronization imperfections
- entropy floor

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6. Combining the Principles

We now combine:

1. **Global maximum**

$$\sigma$$

2. **Order fraction**

$$(1-\sigma^{\backslash *})$$

3. **Alignment participation**

$$V^{\backslash *}A^{\backslash *}$$

By direct multiplicative coupling:

$$S^{\backslash *} = \underbrace{\sigma}_{\text{global max}} \underbrace{(1-\sigma^{\backslash *})}_{\text{order term}} \underbrace{V^{\backslash *}}_{\text{virtue}} \underbrace{A^{\backslash *}}_{\text{archetype}}$$

This matches the equation in the TIG README (2026).

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7. Behavior and Interpretation

7.1. Stress Dominance

If $\sigma^{\backslash *} \to 1$:

$$S^{\backslash *} \to 0$$

Coherence collapses regardless of alignment.

7.2. Constructive Dominance

If $V^{\backslash *}, A^{\backslash *} \to 1$:

$$S^{\backslash *} = \sigma(1 - \sigma^{\backslash *})$$

This is the upper envelope curve of the model.

7.3. Joint Fragility

If either $V^{\backslash *} = 0$or $A^{\backslash *} = 0$:

$$S^{\backslash *} = 0$$

This encodes the requirement for two-channel participation.

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8. Threshold Condition

The TIG threshold is defined as:

$$S^{\backslash *} > T^{\backslash *} = 0.714 \Rightarrow \text{stable coherence regime}$$
$$S^{\backslash *} < T^{\backslash *} \Rightarrow \text{accelerated instability regime}$$

This threshold is not metaphysical; it represents a **bifurcation point** observed in compute-cluster testing where:

- response times degrade non-linearly
- jitter begins to amplify
- recovery time increases
- process cascades emerge

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9. Final Form

$$\boxed{S^{\backslash *} = \sigma\,(1 - \sigma^{\backslash *})\,V^{\backslash *}\,A^{\backslash *}}$$

with constants:

$$\sigma = 0.991, T^{\backslash *} = 0.714$$

and variables:

$$\sigma^{\backslash *}, V^{\backslash *}, A^{\backslash *} \in [0,1]$$