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Dr. Abir Igamberdiev
Editor-in-Chief
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Dear Dr. Igamberdiev,

I am pleased to resubmit my revised manuscript titled “Intelligence as High-Dimensional Coherence: The Observable Dimensionality Bound and Computational Tractability” (BIOSYS-D-25-00880) for reconsideration in *BioSystems*.

I thank you and the reviewers for the constructive feedback, which has substantially strengthened the manuscript. The reviewers recognized the work’s conceptual originality while correctly identifying the need for (1) quantitative demonstration of the theoretical claims, (2) clearer empirical grounding, and (3) improved accessibility and structure. I have addressed all major concerns through extensive revisions.

Major Changes in Response to Reviewer Feedback:

1. Numerical simulations added (Reviewer 2’s primary concern): I now provide four complete Python simulation codes demonstrating:

- Collision-free computation in high-dimensional continuous systems vs. collision-heavy discrete enumeration
- VAS scaling showing linear collision count ($\sim 4n$) for discrete vs. zero for continuous across dimensions $n = 2$ to 100
- Spontaneous code formation through Hebbian pathway strengthening
- Quantitative comparison validating the dimensional tracking bound

All code is provided as supplementary material with full documentation and reproducibility guarantees.

2. Empirical grounding and testable predictions (Reviewer 2): I have:

- Added concrete numerical example using MEG parcellation data showing cortex operates at $D_{eff}/D_{crit} \sim 10^2$ (Section 3.2)
- Derived observable dimensionality bound $D_{crit} = C_{obs}\tau_e/(\alpha h_\varepsilon)$ with explicit parameter values
- Provided specific predictions for coherence times, power scaling, and dimensional collapse signatures (Section 8)
- Connected to measurable biological proxies including neural oscillations, MEG coher-

ence, and metabolic efficiency

3. Structural improvements and accessibility (Reviewer 1):

- Reorganized abstract and introduction for clearer logical flow
- Added explicit “Structure and thesis: What’s new” section distinguishing my contributions from existing frameworks
- Included summary sentences after key derivations (Theorems 1 & 2)
- Clarified physical assumptions vs. derived implications throughout
- Trimmed overall length while expanding critical explanations

4. Methodological rigor and clarity:

- Made irreducibility assumptions explicit in Theorem 1
- Added “Simulation Limitations and Assumptions” subsection
- Distinguished measurable observables from theoretical constructs
- Connected framework to Ashby’s law of requisite variety, morphological computation, and reservoir computing
- Expanded discussion of compressible vs. irreducible complexity

Title and Framing Changes:

I have retitled the manuscript to emphasize the *Observable Dimensionality Bound* as the central quantitative contribution. The new framing clarifies that high-dimensional coherence is not speculative philosophy but a thermodynamic necessity arising from measurement limits, computational complexity, and Landauer’s principle. The VAS simulations provide concrete demonstration that this is not merely conceptual but operationally verifiable.

Preservation of Core Thesis:

While I have significantly strengthened empirical grounding and quantitative support, the manuscript retains its theoretical ambition: explaining *why* biological intelligence must be high-dimensional as a consequence of thermodynamics and information theory, not merely observing that it is. The addition of simulations and empirical predictions transforms this from philosophical speculation into a testable theoretical framework.

I believe the revised manuscript now meets *BioSystems*’ standards for scientific rigor while preserving the conceptual originality that reviewers recognized. The work provides both formal theory and concrete implementation, bridging abstract principles and measurable phenomena.

A detailed point-by-point response to all reviewer comments is provided separately.

Thank you for the opportunity to revise and resubmit this work. I look forward to your decision.

Sincerely,

Ian Todd
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