Technical Abstract

HDT² Pilot v2 extends the diagnostic framework introduced in *HDT² Pilot v1*, in which token-level Shannon entropy was shown to contain a measurable, repeatable geometric structure across multi-step reasoning sequences. Pilot v1 demonstrated two foundational results: (i) entropy bands can be calibrated within a model to expose **epistemic regimes**—stable, ambiguous, and underdetermined states of reasoning; and (ii) alignment of these bands across models is **conditional**, succeeding only when models share compatible uncertainty manifolds. These findings established both the feasibility of entropy-based diagnostics and the architectural limits of portability.

Pilot v2 shifts focus from feasibility to **characterization and control**. Its technical goals include: (i) describing the internal structure and transitions of epistemic regimes; (ii) determining when two models exhibit comparable entropy geometry; (iii) evaluating whether regime boundaries are task-general or task-specific; and (iv) examining how regime exposure can support adaptive system behavior, including abstention, hedging, clarification prompting, and tool invocation.

Pilot v2 remains an exploratory, falsifiable research program. It does not claim universality, causal explanation, or hallucination detection. Instead, it proposes entropy geometry as a substrate for uncertainty-aware control and invites formal investigation into the mechanics of these regimes, their stability, and their cross-model comparability. This versioned release provides a complete technical statement and is intended to support collaboration across uncertainty quantification, LLM safety, control theory, and cognitive modeling.