ITEM #225 - Hybrid DBM × LLM Continuation: Proposal–Adjudication Architecture for Observer-Centric Trajectory Prediction

Conversation：飞行器与动物轨迹分析

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DBM-COT ITEM #225 (EN)

Title

Hybrid DBM × LLM Continuation: Proposal–Adjudication Architecture for Observer-Centric Trajectory Prediction

Abstract

We define a hybrid algorithmic architecture where an LLM contributes candidate future structural continuations ("proposals") based on trajectory IR signatures, while DBM Structural Intelligence performs metric-based adjudication ("selection") using decomposable evidence and risk-aware scoring. This design preserves DBM's auditable, observer-centric, structure-first guarantees while leveraging training-based models for hypothesis expansion and knowledge priors. The hybrid is implemented as a strict contract: LLM never issues final decisions; DBM remains the adjudicator with explicit rejection capability and evidence chains.

1. Motivation

Observer-centric motion prediction is structurally rich but noisy and often underdetermined. Training-based models are strong at generating plausible hypotheses, yet typically lack auditability and robust rejection. DBM, conversely, provides structural stability and metric explainability once IR is available. The optimal synthesis is proposal–adjudication: LLM expands the candidate space; DBM verifies, ranks, and explains outcomes.

2. Core Contract

1. LLM (or any proposer) outputs **ContinuationCandidate** objects: future event skeletons + soft priors + notes.
2. DBM ranks candidates using **DbmContinuationRanker** based on:

- pattern family matches,
- signature/event consistency,
- penalty for implausible transitions,
- distance/evidence decomposition.

3. DBM may reject all candidates when confidence is low or oscillation/risk is high.

3. Inputs and Outputs

Inputs: TrajectoryIr (L0/L2/L3) + Top-K pattern family matches (optional but recommended).
Outputs: Ranked continuations with evidence chain and confidence.

4. Benefits

- Combines LLM's broad priors with DBM's verifiable scoring.
- Keeps prediction controllable, explainable, and rejectable.
- Enables active sensing hints downstream (optional extension).

5. Scope

This item defines structural continuation, not full physics simulation, intent certainty, or policy optimization.

DBM-COT ITEM #225（中文）

标题

DBM × LLM 双围攻延展预测：Proposal–Adjudication 协同架构（面向观察者中心运动轨迹）

摘要

我们定义一种协同架构：LLM 作为“候选生成器（proposal）”提供若干未来结构延展候选；DBM 作为“裁决器（adjudication）”用可分解度量与证据链对候选进行验证、排序与拒答控制。该设计保留 DBM 的结构可验证、可解释、可治理特性，同时利用训练模型在候选空间扩展与软先验知识上的优势。硬约束是：LLM 不做最终判决，DBM 保持裁决权与拒答权。

1. 动机

运动轨迹预测天然噪声大、信息不完备。训练模型善于给出“看起来合理”的猜测，但难以审计与拒答；DBM 一旦拿到 IR，则可提供结构稳定性与距离解释性。最佳融合方式是：LLM 扩候选，DBM 做裁决。

2. 核心契约

- Proposer（可由 LLM 实现）输出 ContinuationCandidate：未来事件骨架 + 软先验 + 说明。
- DBM Ranker 基于模式族、签名一致性、转移惩罚与证据链进行排序。
- DBM 可以在不确定时拒答全部候选。

3. 输入输出

输入：TrajectoryIr（含 L2/L3）及可选 Top-K family matches。
输出：排序后的未来结构延展候选（含证据链与置信度）。

4. 价值

- 既满足业界对训练范式的信任预期，又不牺牲 DBM 的可解释与可控。
- 为后续主动观测建议（Active Sensing）留出接口扩展位。

5. 范围

本 ITEM 只定义结构延展预测，不涉及物理仿真、意图确定性或控制策略优化。