ITEM #253 - **Minimal Evolution Threshold, Path Dependency, and the Limits of World Models**

Conversation: 最小进化门槛与世界模型

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DBM-COT ITEM #253 (EN)

Minimal Evolution Threshold, Path Dependency, and the Limits of World Models

Abstract

Recent progress in *world model–based reinforcement learning* suggests that sufficiently accurate internal simulations of the physical world may lead directly to Artificial General Intelligence (AGI). This position paper examines that claim through the lens of the **Digital Brain Model (DBM)** and its core principle of **Minimal Evolution Threshold (MET)**. We argue that while world models can significantly accelerate learning within a fixed environment, they inherently reinforce **path dependency** and are structurally insufficient to guarantee the emergence of general intelligence. Drawing on DBM's experience with **ACLM Calling Graphs**, **Phase-based pruning**, and the **"Thousand-Claws Dragon" problem**, we show that world models tend to collapse rich environments into narrow, reward-dominated decision paths rather than fostering genuinely transferable structural intelligence.

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1. Minimal Evolution Threshold as a Structural Principle

The **Minimal Evolution Threshold (MET)** principle in DBM states:

At any point in an intelligence system's evolution, the system preferentially advances along the lowest-cost, currently reachable path that does not require introducing new structural primitives.

This principle is:

- **Local**, not global
- **Structural**, not value-laden
- **Algorithm-agnostic**, appearing in biological brains, heuristic reasoning, and engineered systems

MET explains why intelligent systems:

- Favor heuristic shortcuts
- Aggressively prune low-contribution dimensions
- Accumulate competence through reusable calling paths rather than exhaustive world modeling

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2. Path Dependency Is Not a Bug — It Is the Default

Empirical evolutionary history demonstrates that intelligence does **not** emerge via smooth accumulation of minimal steps alone. Instead:

- Long periods of MET-driven local optimization are punctuated by **external shocks**, **structural mutations**, or **environmental regime changes**
- These events alter the **structure space itself**, not merely trajectories within it

Thus, MET governs *movement within a given structure space*,
but it does **not** explain how new structure spaces are created.

World-model approaches frequently conflate these two layers.

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3. World Models Through the Lens of ACLM

World-model-based systems (e.g., Dreamer-style architectures) are typically trained in simulated environments such as games or embodied virtual worlds. From an **ACLM (Action–Calling–Link–Map)** perspective, this setup implies:

1. A single **root node** (environment start state)
2. A rapidly expanding **calling graph** generated via imagination rollouts
3. Reward-driven pruning that selects a small number of **thickest calling paths**

In practice, this results in:

- A **tree-style ACLM Calling Graph**
- One or a few dominant paths optimized for task success
- Sensory-rich world representations serving only as *constraints*, not decision drivers

Human-like 3D perception does not become the core intelligence; it is structurally demoted once it ceases to increase reward gradients.

4. Lessons from the "Thousand-Claws Dragon" Problem

DBM's experience with large combinatorial search problems ("Thousand-Claws Dragon") reveals a consistent pattern:

- Rich candidate generation is cheap
- Structural pruning is decisive
- Intelligence emerges from *what is discarded*, not from what is simulated

World models dramatically expand candidate space but rely on reward optimization to collapse it. This process almost inevitably produces:

Efficient task solvers with narrow structural scope,
not broadly transferable intelligence.

5. Limits of World Models as an AGI Foundation

We identify three structural limitations:

(1) Predictive Consistency ≠ Causal Understanding
World models excel at rolling forward latent dynamics but do not inherently encode causal differentials or reusable structural invariants.

(2) Data Density ≠ Structural Density
High-resolution video or sensory data rarely translates into high decision relevance after Phase-based pruning.

(3) Perfect Simulation Reinforces Path Lock-In
As world models improve, they accelerate convergence toward existing optimal paths, reducing opportunities for structural divergence or innovation.

6. Two Diverging Paradigms

Dimension	World Model Paradigm	DBM Paradigm
Core Assumption	Simulate reality	Operate on structure
Optimization Target	Rollout accuracy	Structural differentials
Risk	Path lock-in	Structural complexity
Failure Mode	Over-specialization	Engineering difficulty
AGI Claim	Emergence via scale	Emergence via structure

7. A Non-Adversarial Position

This paper does **not** claim that world models are useless. Rather:

World models are powerful accelerators within a structure space,
but they are neither necessary nor sufficient for AGI.

Within DBM, world models are better understood as:

- High-cost **environmental generators**
- Sources of counterfactual candidates
- Subordinate components, not architectural centers

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8. Conclusion

Minimal Evolution Threshold ensures that intelligence systems preferentially follow the easiest viable paths. World models, by dramatically lowering the cost of internal trial-and-error, intensify this tendency. Without explicit mechanisms for structural differentiation, causal abstraction, and calling-path reorganization, world models are more likely to **entrench path dependency** than to transcend it.

AGI, therefore, is unlikely to emerge from simulation fidelity alone. It requires a **structural intelligence framework** capable of recognizing, comparing, and reorganizing the very paths along which intelligence evolves.

DBM-COT ITEM #253（中文）

最小进化门槛、路径依赖与世界模型的能力边界

摘要

近年来，以“世界模型”为核心的强化学习路线被广泛认为是通往通用人工智能（AGI）的关键路径。本文基于 **数字脑模型（DBM）** 的核心原则——**最小进化门槛（Minimal Evolution Threshold, MET）** ，对这一观点进行结构性审视。我们指出：世界模型虽然能够在既定环境中显著加速学习，但其本质上会强化**路径依赖**，在结构层面不足以保证通用

智能的产生。结合 DBM 在 **ACLM 调用图**、**分阶段剪枝** 以及 **“万爪龙问题”** 中的实践经验，本文论证：世界模型往往将高度丰富的环境压缩为少数奖励主导的决策路径，而非孕育可迁移、可重组的结构智能。

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1. 最小进化门槛：一种结构性原则

DBM 所提出的最小进化门槛原则指出：

在任意时刻，智能系统倾向于沿着当前可达、代价最低、无需引入新结构的路径继续演化。

这一原则具有以下特征：

- 局部而非全局
- 结构性的而非价值性的
- 跨生物与工程系统普遍存在

它解释了为何智能系统：

- 偏好启发式而非全搜索
- 会主动丢弃边际贡献极低的维度
- 通过可复用的调用路径积累能力，而非构建完整世界模型

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2. 路径依赖不是缺陷，而是默认态

进化史清楚表明，智能并非由连续的最小步长平滑累积而来：

- 长期的局部优化阶段，往往被
  灾变、突变或外部冲击 所打断
- 这些事件改变的是**结构空间本身**，而非其中的路径选择

因此：

- 最小进化门槛支配的是**既定结构空间内的演化**
- 而非**结构空间如何被创造或重置**

世界模型路线在此处常常发生概念混淆。

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3. 从 ACLM 视角理解世界模型

以游戏或虚拟环境训练的世界模型系统，在 **ACLM（Action–Calling–Link–Map）** 框架下，通常呈现为：

1. 以环境初始状态为根节点
2. 通过“想象 rollout”快速扩展调用图
3. 在奖励函数驱动下进行强剪枝

其结果往往是：

- 一个**树形 ACLM 调用图**
- 一条或少数几条“最粗”的最优路径
- 感知与世界细节仅作为约束条件存在

类人的三维世界理解并不会成为智能核心，而是在不再提升奖励梯度时被结构性降权。

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4. 万爪龙问题的启示

DBM 在处理大规模组合搜索（“万爪龙问题”）时反复验证了一个规律：

- 候选生成并不稀缺
- 剪枝才是智能的决定性环节
- 智能更多来源于**被丢弃的部分**

世界模型极大扩展了候选空间，但依赖奖励函数将其压缩。最终更可能产生的是：

在特定任务上极高效、但结构迁移能力极弱的智能体。

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5. 世界模型作为 AGI 基石的三重限制

（1）可预测性 ≠ 因果理解

世界模型擅长状态滚动，却不自动获得因果差分与结构不变量。

（2）数据密度 ≠ 结构密度

高分辨率感知数据在 Phase 剪枝后，往往对决策贡献极低。

（3）模拟越完美，路径越固化

世界模型越强，越容易加速既有最优路径的锁死，反而压缩结构创新空间。

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6. 两条正在分岔的路线

维度	世界模型路线	DBM 路线
核心信念	模拟现实	操作结构
优化目标	rollout 精度	差分结构
主要风险	路径锁死	结构复杂
失败形态	过度专用化	工程难度
AGI 逻辑	规模涌现	结构涌现

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7. 非对立结论

本文并不否认世界模型的价值，而是指出：

世界模型是结构空间内的加速器，
但既非 AGI 的必要条件，也非充分条件。

在 DBM 体系中，它更适合被视为：

- 高成本环境生成插件
- 反事实候选来源
- 从属于结构智能主干的组件

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8. 结论

最小进化门槛决定了智能系统会优先选择最容易成功的路径。世界模型通过降低试错成本，进一步强化了这一趋势。若缺乏显式的结构分化、因果抽象与调用路径重组机制，世界模型更可能**加固路径依赖**，而非突破它。

因此，AGI 不会仅由更真实的模拟自然产生。它需要一种能够识别、比较并重组自身演化路径的**结构智能框架**。
