PREDICTIVE FEASIBILITY

PFA

Real-World Validation Case 04

Predictive Structure Under Extreme Ambiguity

Question

Can reproducible predictive structure exist inside highly stochastic and short biological trajectories?

To investigate this, the Predictive Feasibility Assessment framework was applied to real-world fastSPT biological trajectory data.

These systems represent one of the most challenging environments tested so far.

The trajectories contain:

- Short observation windows
- State switching
- Diffusion mixtures
- Strong overlap
- High stochasticity

At first glance, stable prediction appears unlikely.

What Was Evaluated?

The analysis focused on:

- entropy
- overlap ambiguity
- persistence
- inferability structure

- forecasting behavior
- cross-run reproducibility

Result

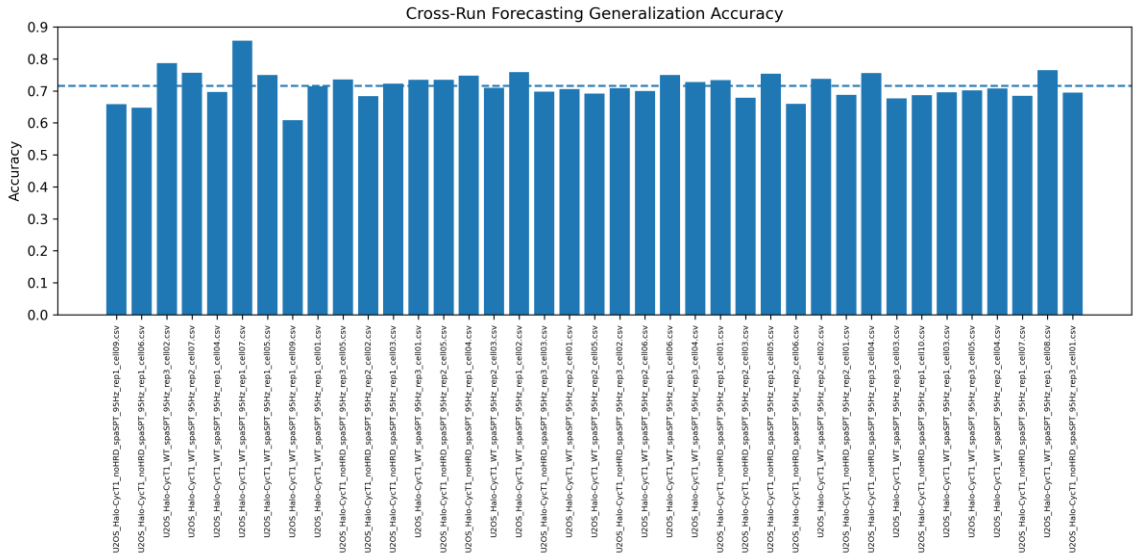
Despite extreme stochastic behavior, substantial predictive structure remained visible.

The majority of trajectories remained inside stable or partially stable predictive regimes.

This was observed across:

- independent runs
- independent cells
- different biological conditions

Figure 1 — Predictive Structure in fastSPT Trajectories



Caption

Predictive feasibility within biological fastSPT diffusion trajectories.

Despite short trajectories, state switching, overlap ambiguity, and strong stochastic variation, reproducible structure remains detectable across multiple conditions.

The figure demonstrates that predictive feasibility is not restricted to slow degradation systems and may also emerge within highly dynamic biological environments.

Why This Matters

Many predictive frameworks perform well only in slow and highly structured systems.

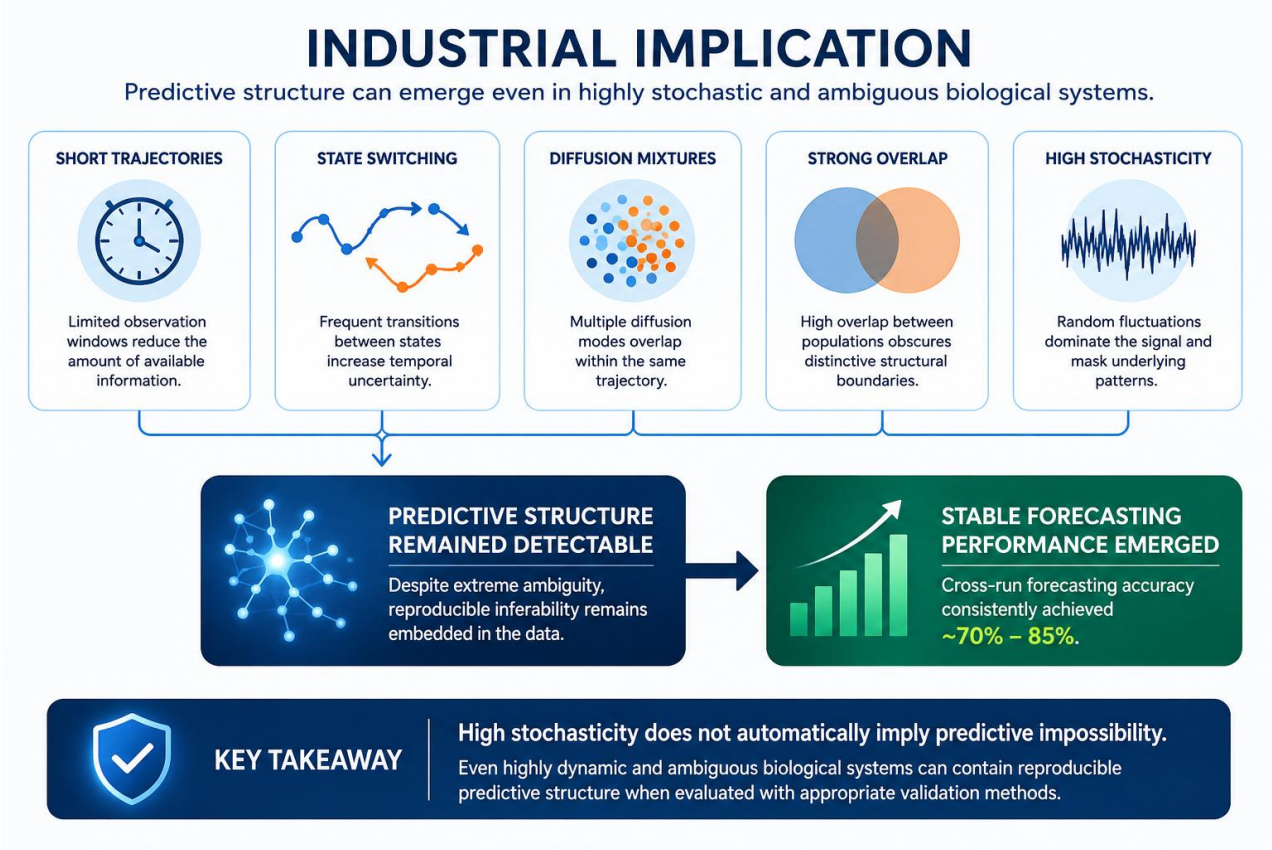
This validation demonstrates that predictive feasibility concepts can remain meaningful even under extreme uncertainty.

Industrial Implication

Many predictive frameworks assume that highly stochastic biological systems are inherently unpredictable.

This validation demonstrates that predictive structure may remain detectable even under extreme ambiguity.

The infographic below summarizes the practical implications.



Key Takeaway

High stochasticity does not automatically imply predictive impossibility.

Even highly dynamic systems can contain reproducible predictive structure when evaluated using appropriate validation methods.