

Stable Learning: AI-Driven Lyapunov Functions

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Lyapunov stability determines a system's stability by generating an energy-like function that decreases over time. Thus, it guarantees convergence to equilibrium without specifically and explicitly solving the nonlinear system equation. The complexity of this approach lies in the identification process of the Lyapunov function. A Lyapunov function is not chosen at random; it is constructed based on the system dynamics in such a way that it reflects the stability behavior of the system under study. The main challenge of the Lyapunov approach is that there is no direct constraint between the energy-like function

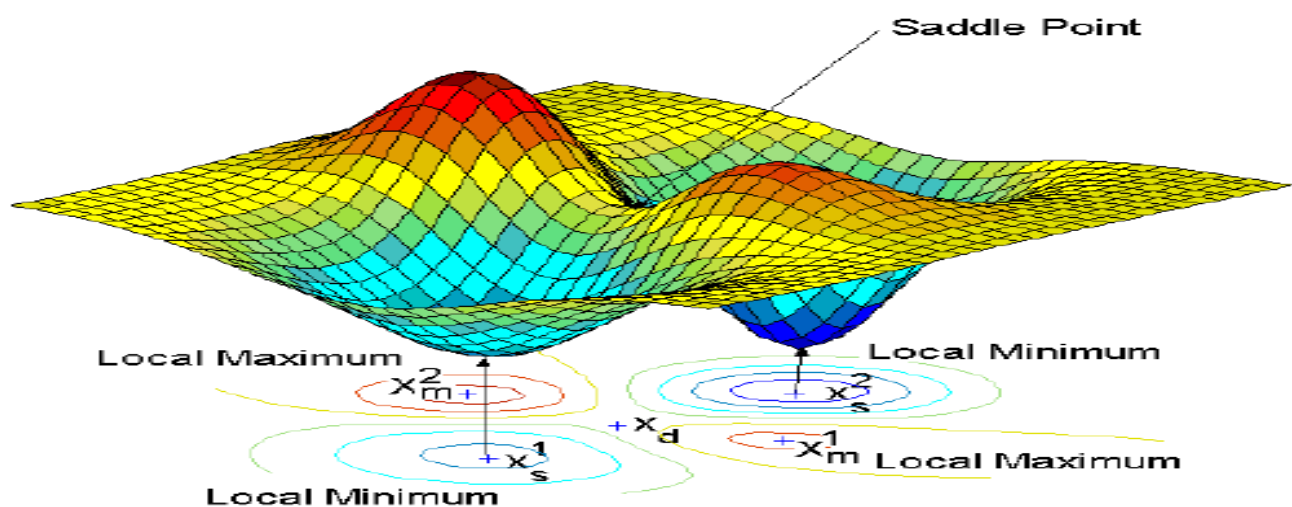
between the energy-like function and the system equation. However, an implicit geometric constraint: the system dynamics must be consistently decreasing in time. The rapid growth and advancements in artificial intelligence have opened new possibilities for integrating AI into Lyapunov-based stability analysis by learning candidate Lyapunov functions directly from data. This approach enables automated and scalable verification of system stability, while also allowing AI to propose suitable Lyapunov functions tailored to specific system dynamics. This approach enables automated and scalable verification of system stability, while also

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But the deeper problem is conceptual. Even when sentiment is correctly classified, the output usually stops at

“68% positive.” That number doesn't tell a marketing team whether to fix product, the price, the packaging, or the post-sale service.

Sentiment analysis has been treated as an end, when it should be an input - into pricing, positioning, and customer-experience decisions. What's missing is a shared language between NLP researchers and the people making real business decisions.



Lyapunov Function Landscape Illustrating Stability and Equilibrium Points