PoC: Navigation for a High-Inertia Controlled Object in a Lyapunov-Like State Space

Context and motivation

This proof of concept explores navigation and positioning for a controlled object with pronounced inertial behavior, operating in a state space that contains both stable regions and neighborhoods of unstable equilibrium. The focus is reliable positioning where inertia, delays, disturbances, and estimation uncertainty are dominant.

Goal

Validate controlled positioning and holding near unstable equilibrium. The PoC treats real-time discipline as part of the physical system: bounded latency, jitter, and cycle repeatability directly affect achievable stability and precision.

Implementation as a test stand

Implemented as an engineering stand combining the computational control core, a sensing loop for state estimation, a controlled actuation layer, and an experiment environment with logging and replay for repeatable scenarios and comparisons.

Outcome and deployment

The stand demonstrated controlled positioning behavior in the target regime and produced baseline architecture and artifacts for scaling. Selected elements were adapted into NDA-covered systems; therefore, this public summary intentionally stays high-level.