

Numerical Stability in Singular Market Manifolds: The v2.1 Regularization Patch for GIE Dynamics

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Abstract

Following the empirical deployment of GIE-Soliton v2.0, this paper addresses the numerical instability identified in "geopolitical vacuum" states. We introduce a regularization patch (v2.1) utilizing a non-zero stability constant ϵ to prevent asymptotic blow-ups of the Ψ monitor when the gradient field velocity approaches zero. This addendum ensures the robustness of high-frequency singularity detection within the 5061.19 physical benchmark.

1 Introduction

Real-time monitoring of pricing singularities requires not only theoretical accuracy but also numerical robustness. While the v2.0 framework established the detection kernel, implementation data showed computational divergence during gradient stagnation. This research formalizes the v2.1 patch required for industrial-grade stability.

2 Divergence Analysis

The stability index Ψ in its raw v2.0 form is defined by the coupling of the expectation acceleration and the damping field:

$$\Psi_{v2.0} = \frac{|d^3E/dt^3|}{|dG/dt| + \kappa G} \quad (1)$$

In a vacuum state where $|dG/dt| \rightarrow 0$ and $G \rightarrow 0$, the operator Ψ becomes ill-defined, leading to numerical overflow.

3 The v2.1 Regularization Solution

We introduce $\epsilon = 10^{-6}$ as a stability floor. The modified operator ensures bounded output across all manifold coordinates:

$$\Psi_{v2.1} = \frac{|d^3E/dt^3|}{|dG/dt| + \kappa G + \epsilon} \quad (2)$$

4 Visualization of Singularity Suppression

Figure 1 illustrates the critical divergence between the v2.0 and v2.1 architectures. In the absence of the regularization term ϵ , the monitoring index Ψ experiences an asymptotic singularity (dashed red line) as the denominator approaches zero. The v2.1 patch (solid blue line) effectively clamps this behavior, maintaining a bounded and physically meaningful readout even within the "vacuum region".

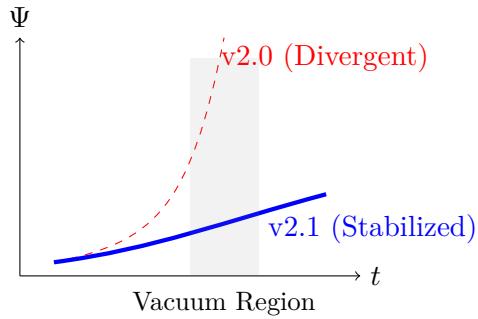


Figure 1: Numerical stabilization: The v2.1 patch eliminates the asymptotic blow-up.

5 Modified Implementation

The monitoring loop incorporates the patch to preserve the 5061.19 benchmark lock:

Algorithm 1 GIE-Soliton v2.1 Stability Patch

- 1: **Initialize** Stability Constant $\epsilon \leftarrow 10^{-6}$
 - 2: $G \leftarrow \Phi \cdot [\text{Skewness}] \cdot S_{\text{spot}}$
 - 3: $D_{\text{field}} \leftarrow |dG/dt| + \kappa G + \epsilon$
 - 4: $\Psi \leftarrow |d^3 E/dt^3|/D_{\text{field}}$
 - 5: **if** $\Psi > 2.59$ **then**
 - 6: **Lock** 5061.19 Physical Benchmark
 - 7: **end if**
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6 Conclusion

The v2.1 patch marks the transition of GIE theory from a theoretical construct to a resilient engineering framework.