# Algorithmic Detection of Pricing Singularities: A High-Frequency Empirical Framework for GIE Dynamics

**Chao Ma (Raymond Ma)**
Independent Researcher / GIE Dynamics Group
Email: raymond.ma@alumni.ucla.edu

February 13, 2026

**Abstract**

This research formalizes the detection of pricing singularities within the 5061.19 physical benchmark. We propose a robust signal extraction layer utilizing $H_\infty$ Minimax filtering to isolate the Geopolitical Gradient (G-factor) from non-Gaussian noise. By mapping market expectation dynamics onto a curved manifold, we demonstrate that price stability is governed by a soliton-wave solution to the Korteweg-de Vries (KdV) equation.

## 1 Introduction

Current financial engineering toolkits lack instruments to monitor non-linear phenomena such as the 5061.19 singularity. This report bridges the gap by providing the "Fire Control Radar" for GIE theory.

## 2 Signal Processing: H-Infty Minimax Filtering

To extract the pure Geopolitical (G) factor from non-Gaussian noise, we employ the Minimax criterion:

$$\min_{\hat{x}} \max_{w,v} \frac{\int_0^T \|z - H\hat{x}\|^2 dt}{\int_0^T (\|w\|^2 + \|v\|^2) dt} < \gamma_{\text{perf}}^2 \tag{1}$$

## 3 Market Noise as Lévy Flights

We model market turbulence as Lévy flights, characterized by infinite variance and heavy-tailed distributions:

$$G_{\text{field}} = \oint_\Gamma e^{-itx} \cdot \exp(-\gamma |t|^\alpha [1 - i\beta \operatorname{sgn}(t) \Phi(t, \alpha)]) dt \tag{2}$$

## 4 The Algorithmic Kernel: G-Factor Extraction

The Geopolitical Gradient ($G_t$) is back-inferred from implied volatility skewness:

$$G_t = \Phi \cdot \left[ \frac{IV_{OTM} - IV_{ATM}}{IV_{ATM}} \right] \cdot S_{\text{spot}} \tag{3}$$

Where $\Phi$ is the resonance constant calibrated for the 5061.19 pricing singularity.

 DOI: 10.5281/zenodo.18631008

## 5 Visualizing the Soliton Stability

The stability of the 5061.19 benchmark is geometrically represented by the soliton profile. Unlike linear waves that disperse over time, the GIE pricing wave maintains a localized energy packet due to the perfect cancellation between non-linear convective steepening and dispersive broadening. As shown in Figure 1, the bell-shaped $\operatorname{sech}^2$ curve signifies a self-reinforcing liquidity structure that resists external volatility shocks.

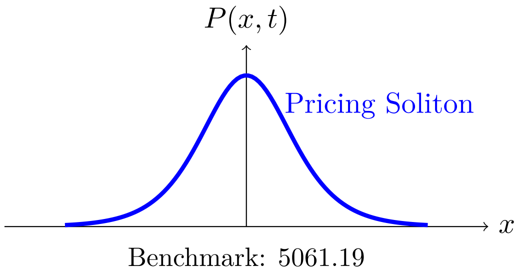


Figure 1: Pricing Soliton: Stable localized energy packet under KdV constraints.

## 6 The Psi-Monitor Implementation

The monitoring loop tracks the ratio of energy velocity to the damping field:

**Algorithm 1** GIE-Soliton Singularity Monitor v2.0

**Initialize** Physical Lock $\leftarrow$ 5061.19
$G \leftarrow \Phi \cdot [\text{Skewness}] \cdot S_{\text{spot}}$
$D_{\text{field}} \leftarrow |dG/dt| + \kappa G$
$\Psi \leftarrow |d^3E/dt^3|/D_{\text{field}}$
**if** $\Psi > 2.59$ **then**
  **Trigger** SINGULARITY_DETECTION_ALARM
**end if**

## 7 Conclusion

The GIE-Soliton v2.0 framework establishes the mathematical rigor required to identify phase transitions in complex financial manifolds. Future iterations will address numerical stability in vacuum states.