The UNNS Calculator: Exploring Recursion, Geometry, and Dynamics

UNNS Research Initiative

Abstract

The UNNS Calculator provides a novel bridge between classical algebraic systems and the recursive grammar of Unbounded Nested Number Sequences (UNNS). Unlike traditional calculators which deliver static numeric outputs, the UNNS Calculator emphasizes recursive dynamics, structural embeddings, and geometric visualizations. This paper outlines its prominence, significance, novelty, and functions across three modes: Quadratic equations, Oscillators, and Fourier Phasors.

1 Introduction

The **UNNS Calculator** is not a numerical engine in the conventional sense. It is a conceptual explorer of recursive systems. By embedding algebraic recurrences into recursive dynamics, it allows users to see not only results but also *how sequences evolve*, how stability manifests, and how resonance emerges.

2 Prominence

Quadratic equations, oscillators, and phasors have long been fundamental in mathematics and physics. The UNNS Calculator reformulates them through the lens of recursive dynamics:

- Quadratic roots, when complex, are no longer abstract objects but visualized as geometric orbits.

- Oscillator traces reveal stability thresholds based on damping and rotation, providing immediate visual feedback.

- Phasor dynamics bridge discrete recursion with Fourier analysis, highlighting periodicity and resonance.

3 Significance

The UNNS Calculator is significant for three main reasons:

1. **Mathematical Insight**: It shifts focus from static results to dynamic recursion, thereby visualizing algebraic structures.

2. **Educational Value**: It provides an accessible demonstration of complex numbers, stability, and periodicity through live graphics.

3. **Research Potential**: It extends UNNS into physical analogies, suggesting connections to wave propagation and field theory.

4 Novelty

The novelty lies in reframing familiar operations as recursive geometries:

- Numbers are shown as *events in recursion*, not just solutions.

- Complex numbers appear as visible rotations and orbits, not as "imaginary" constructs.

- Stability and resonance become measurable through recursive dynamics.

5 Functions

The calculator currently includes three modes:

5.1 Quadratic Mode

Solves $ax^2 + bx + c = 0$ and visualizes roots:

- Real roots $\rightarrow$ points on the line.

- Complex roots $\rightarrow$ circular orbits around a center.

5.2 Oscillator Mode

Implements recursive rotation–dilation with damping:

$$v_{n+1} = \alpha \rho R(\theta) v_n,$$

where ρ is scale, θ rotation, and α damping. The trace reveals spirals (stable if $|\alpha\rho| < 1$).

5.3 Phasor Mode

Plots

$$x_n = \cos(n\theta), \quad y_n = \sin(n\theta),$$

demonstrating periodicity when θ/π is rational, and quasi-periodicity otherwise.

6   Outlook

The UNNS Calculator will evolve toward:

- Sparklines showing divergence histories.

- Step-by-step animations for recursive iteration.

- Dual comparison panels (Classical vs UNNS dynamics).

7   Conclusion

The UNNS Calculator embodies the central vision of UNNS: numbers as recursive events, structures as dynamic lattices, and mathematics as a living grammar of recursion. It transforms equations into visible, interactive, and interpretable structures, marking a significant step toward establishing UNNS as a research and teaching discipline.