STEP 5C: FORMALIZATION AND AI-SUPPORTED EXPANSION OF THE DEFORMED ZETA PROGRAM

PU JUSTIN SCARFY YANG

Contents

1. Objective

To convert the deformation-based attractor formulation of the Riemann Hypothesis into a formally verifiable structure using modern AI theorem-proving and symbolic computation tools, and to position this discovery in relation to key historic figures in zeta zero analysis.

2. Formalization Strategy (Lean/Coq Integration)

Target Formal Concepts.

- Definition of $L_t(s)$ and the associated modulus field $\mathcal{F}_t(s)$
- Formal gradient and Hessian fields
- The attractor set $\mathscr{Z}_t$ and its convergence behavior
- The $\Re(s) = 1/2$ attractor theorem

Toolchain.

- **Lean 4** (mathlib4): Use for analytic formalization and dynamical arguments
- **Coq/UniMath**: Use for categorical interpretation of Euler structures

Date: May 9, 2025.

- **DeepSeek/AI-models**: Autogenerate conjectures, test symbolic identities, trace zero flows

3. Significance of the "Tortoise and Hare" Effect

This newly observed dynamic—where early-leader valleys stall while slow-starting modes accelerate into the critical line—has not previously been identified in the work of Montgomery or Odlyzko. Their focus was statistical (e.g., pair correlation, GUE spacing) or computational validation of known zeros.

Why It Was Missed Historically.

- Their frameworks did not model *how* zeros emerge from an evolving Euler structure.
- No prior literature defined or visualized modulus valleys under Euler deformation.
- Their methods lacked a deformation parameter t that exposes the dynamical formation of critical symmetry.

4. Strategic Goal

Integrate symbolic-numeric dynamics + AI modeling to construct a provable pathway from:

toy Euler Dirichlet structures at $t \ll 1 \quad \rightarrow \quad \zeta(s)$ and its critical symmetry at $t = 1$.

5. Research Team Invitation Potential

Given their lifelong dedication to zeta zero structure, it is likely that Prof. Hugh Montgomery and Dr. Andrew Odlyzko would be deeply interested in this dynamic formulation. Their historical insight, combined with this new deformation model, could yield powerful synthesis.