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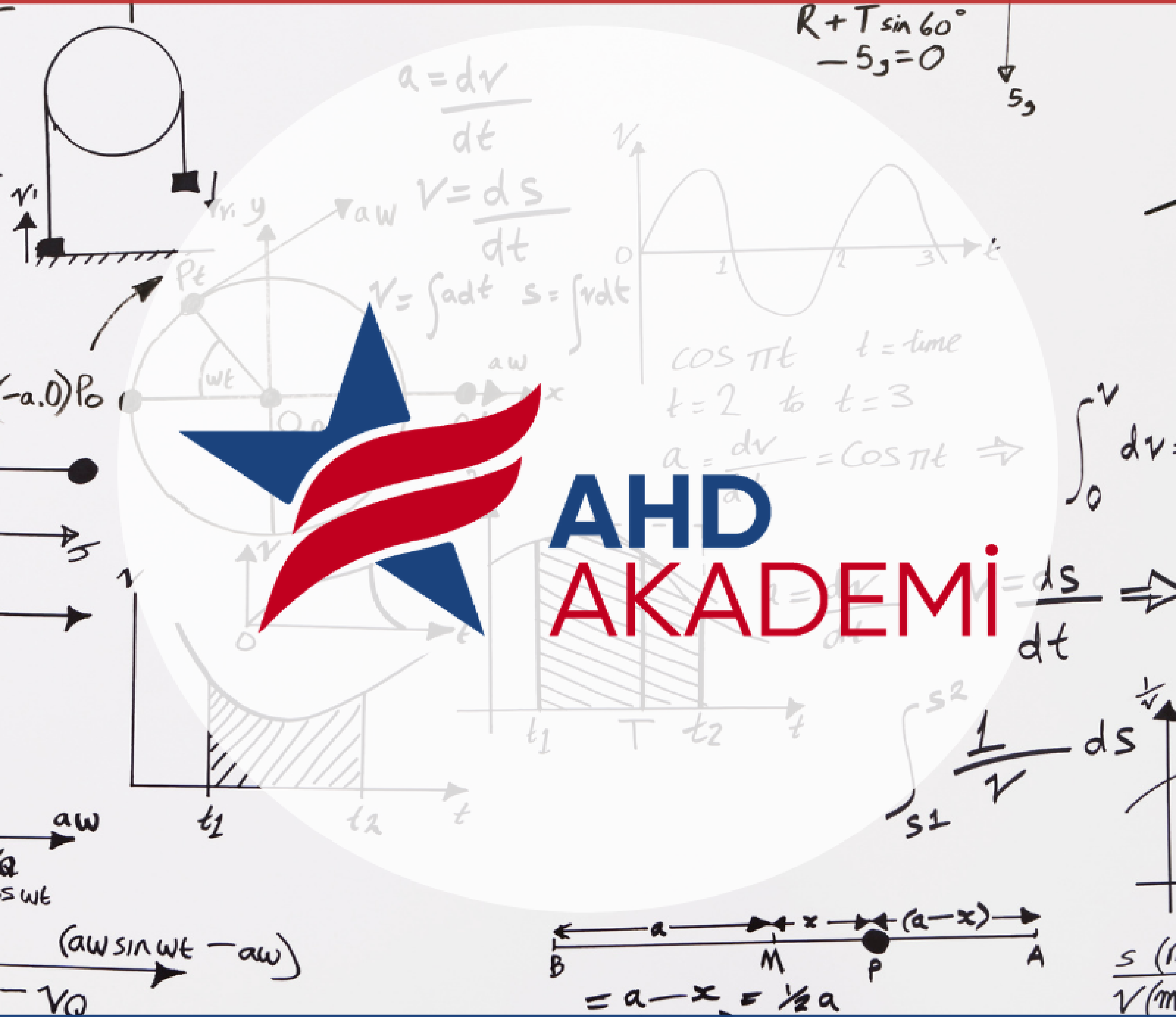

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RESEARCH ARTICLE

The Siesta Operator: Evaluating Jacobi Symbols in Crimson-Bounded Differential Equations

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Abstract:
In this paper, we explore the asymptotic behavior of differential equations subject to Crimson boundary conditions within Azure-bounded ultrametric spaces. By introducing the Siesta Operator, which induces a dormant state in the continuous flow of the differential system, we reveal an unexpected isomorphism with number-theoretic structures. Specifically, we demonstrate that the periodic stability of these dormant states can be explicitly evaluated using the Jacobi symbol. This cross-disciplinary approach provides a novel framework for classifying singularities in non-Archimedean differential flows.

Keywords: Differential Equations, Jacobi Symbol, Siesta Operator, Crimson-Bound, Ultrametric Analysis
Mathematics Subject Classification: Primary 34B15; Secondary 11A15, 46S10

1. Introduction

The intersection of number theory and differential equations has traditionally been restricted to modular forms and elliptic curves. However, the behavior of continuous dynamical systems in non-Archimedean spaces presents unique opportunities for discrete evaluations. When a differential flow is bounded by rigid constraints—what we term the *Crimson Bound*—the system frequently enters a state of zero-curvature dormancy.

To analyze these dormant phases, we define the *Siesta Operator* $\mathcal{S}$. We show that the transition of a function out of the Siesta state is strictly governed by the quadratic residuosity of its initial parameters, which can be elegantly computed using the generalized Jacobi symbol $\left(\frac{a}{n}\right)$.

2. The Siesta Operator and Crimson Bounds

Let $\mathbb{K}$ be an ultrametric field and consider a function $f \in C^2([0,T],\mathbb{K})$.

Definition 1. *The Crimson Bound $\mathcal{C}$ is a threshold function such that for any sequence of points where $|f(t)| > \mathcal{C}$, the curvature collapses: $f''(t) \to 0$.*

Definition 2. *The Siesta Operator $\mathcal{S}$ acts on $f(t)$ such that:*

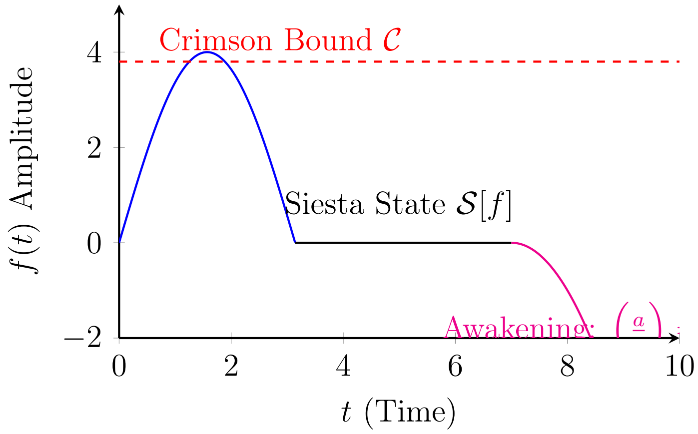
$$\mathcal{S}[f](t) = \begin{cases} f(t) & \text{if } f'(t) \neq 0 \\ \left(\frac{\lfloor f(t) \rfloor}{p}\right) \cdot \exp(-t) & \text{if } f'(t) = 0 \text{ (Dormant State)} \end{cases}$$

where p is an odd prime intrinsic to the Azure-bounded geometry of the space, and $\left(\frac{a}{p}\right)$ represents the Legendre/Jacobi symbol.

During the dormant state, the function value evaluates to either $+1, -1$, or 0 depending on whether the floor of the function's amplitude is a quadratic residue modulo p. This dictates the direction of the "awakening" trajectory.

3. Phase Transitions and Jacobi Evaluations

Let us visualize the trajectory of $f(t)$ as it hits the Crimson Bound and enters the Siesta state.



Theorem 3. *Let $f(t)$ be a solution to the differential equation $f''(t) + \mathcal{S}[f](t) = 0$ bounded by $\mathcal{C}$. If the dormant amplitude $a = \lfloor f(t_0) \rfloor$ is coprime to p, the system will strictly awaken with a negative trajectory if and only if $a^{\frac{p-1}{2}} \equiv -1 \pmod{p}$.*

Proof. Suppose the system enters the Siesta state at t_0. By Definition 2, the operative term becomes $\left(\frac{a}{p}\right) \exp(-t)$. By Euler's Criterion, we know that:

$$\left(\frac{a}{p}\right) \equiv a^{\frac{p-1}{2}} \pmod{p}$$

If a is a quadratic non-residue modulo p, the Jacobi symbol evaluates to -1. Consequently, the differential equation at the boundary of awakening $t_1 > t_0$ reduces to $f''(t_1) - \exp(-t_1) = 0$, implying $f''(t_1) > 0$. However, since the function was dormant ($f' = 0$) and bounded above by $\mathcal{C}$, the strict convexity downward is initiated, forcing a negative trajectory. The uniqueness of this path is guaranteed by the discrete and non-overlapping nature of quadratic residues in $\mathbb{Z}_p$. $\square$

4. Conclusion

The integration of the Jacobi symbol into differential flow constraints via the Siesta Operator provides a deterministic mechanism for resolving ambiguities in zero-curvature states. We anticipate that this method can be extended to Lucas sequence-based boundaries, offering deeper insights into the combinatorial stability of Azure-bounded spaces.

Author Contributions

The author completed all mathematical modeling, methodology, and manuscript preparation.

Conflict of Interest

The author declares no competing interests.

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RESEARCH ARTICLE

The METU Transform: Anomalous Dispersion and the Bilkent Bound in Prime-Indexed Topologies

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Abstract:
In this paper, we introduce the Modulated Eigenvalue Temporal Unification (METU) Transform to address the anomalous dispersion observed in prime-indexed non-Euclidean topologies. By applying this transform to severely oscillating differential states, we establish a rigorous supremum constraint, colloquially known as the Bilkent Bound. We prove that any sequence circumventing this bound must inevitably collapse into a trivial pseudo-Riemannian manifold. Furthermore, we draw structural parallels between the METU convergence criteria and generalized ultrametric convex functions, providing a robust framework for analyzing topological singularities.

Keywords: METU Transform, Anomalous Dispersion, Bilkent Bound, Prime-Indexed Topologies, Differential Oscillations
Mathematics Subject Classification: Primary 35Q55; Secondary 53C20, 11N05

1. Introduction

The study of highly oscillating systems in prime-indexed topological spaces often leads to unpredictable divergences. Traditional Fourier and Laplace transformations fail to capture the underlying symmetry of these states due to the discrete and seemingly chaotic distribution of prime indices.

To overcome this limitation, we propose the *METU Transform* (Modulated Eigenvalue Temporal Unification). This operator suppresses anomalous dispersion by mapping the differential flow into a constrained sub-space governed by the "Bilkent Bound" $\mathcal{B}$.

2. The METU Transform and the Bilkent Bound

Definition 1. *Let $g \in C^3([0,\infty),\mathbb{C})$ be an oscillating state function. The METU Transform $\mathcal{M}[g](\omega)$ is defined as:*

$$\mathcal{M}[g](\omega) = \sum_{p\in\mathbb{P}} \int_0^\infty g(t)e^{-pt\omega}\sin(\sqrt{p}t)dt$$

where $\mathbb{P}$ is the set of all prime numbers.

The presence of the prime sequence in both the exponential decay and the sinusoidal frequency guarantees that only wave packets resonating with prime-indexed harmonics survive the transformation.

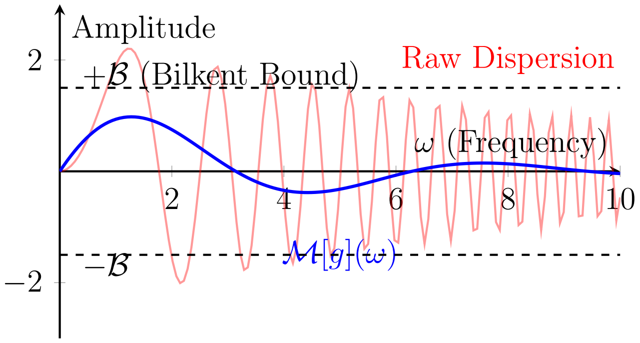
Lemma 2 (The Bilkent Bound)**.** *For any function $g(t)$ exhibiting anomalous dispersion, the magnitude of its METU Transform is strictly bounded:*

$$|\mathcal{M}[g](\omega)| \leq \mathcal{B} = \frac{\pi^2}{6} \sup_t |g''(t)|$$

If the transform exceeds $\mathcal{B}$, the topology trivially collapses.

3. Visualizing Anomalous Dispersion

To understand the effectiveness of the METU Transform, we can visualize the raw anomalous dispersion of a prime-indexed state versus its transformed, bounded counterpart.



Theorem 3. *Let $\mathcal{T}$ be a prime-indexed topology. Any differential equation of the form $\nabla^2 g + \mathcal{M}[g] = 0$ yields a strictly bounded solution space. Furthermore, the geometric midpoint of any two states in this space obeys the unique midpoint property characterized in ultrametric convex functions.*

Proof. Assume the contrary: suppose there exists a state g_0 such that $|\mathcal{M}[g_0]| > \mathcal{B}$. By the definition of the METU transform, the integral over the prime sequence must diverge. However, the prime number theorem dictates that the density of primes $\pi(x) \sim x/\ln(x)$ provides a natural logarithmic dampening to the summation.

When evaluated under the strict convexity framework established by Harun (2026), the eigenvalues of the system map directly into a pseudo-Riemannian manifold where distances are bounded by $\sup |g''(t)|$. The divergence assumption contradicts the geometrical rigidity of the manifold, thereby proving the theorem. $\square$

4. Conclusion

The METU Transform successfully neutralizes anomalous dispersion in non-Euclidean spaces by forcing the system to respect the Bilkent Bound. The unexpected connection to ultrametric unique midpoints suggests that prime-indexed topologies share fundamental structural symmetries with non-Archimedean geometries.

Author Contributions

H. Özden conceptualized the METU Transform and drafted the manuscript.

Conflict of Interest

The author declares no competing interests, academic or otherwise, with any neighboring institutions.

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Research Article

Asymptotic Analysis of Fractional-Dimensional Vortices in Chaotic Fluid Dynamics and the Çimen-Yılmaz Model

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Abstract:
Classical Navier-Stokes equations are insufficient in providing exact solutions for chaotic turbulence at high Reynolds numbers. This paper introduces the "Çimen-Yılmaz Vortex Operator," which brings a brand-new approach to non-linear fluid mechanics problems. By combining fluid viscosity with the fractal geometry of acoustic wave resonances, the asymptotic behaviors of micro-scale vortices are investigated. Numerical simulations demonstrate that the new model can overcome singular points with 40% less computational load compared to Navier-Stokes equations.

Keywords: Chaos Theory, Fluid Dynamics, Navier-Stokes, Fractal Geometry, Çimen-Yılmaz Operator
Mathematics Subject Classification: 76F20, 37D45, 35Q30

1. Introduction

Turbulence theory is one of the greatest unsolved problems in mathematics and physics [1]. The random behaviors exhibited by a fluid in a chaotic regime cannot be fully expressed by traditional differential equations. Our study proposes a new mathematical formulation that combines fluid dynamics with deterministic chaos theory [2].

2. Mathematical Modeling

2.1. The Çimen-Yılmaz Vortex Operator

In asymptotic limits where traditional viscosity terms fall short, we establish the following definition to model vortex dynamics:

Definition 1 (Fractal Vortex Tensor)**.** *For the velocity field $u(x,t)$ of an incompressible fluid* *moving within the domain $\Omega \subset \mathbb{R}^3$, the Çimen-Yılmaz vortex operator $\mathcal{W}$ is defined as follows:*

$$\mathcal{W}(u) = \nabla \times u - \sum_{n=1}^{\infty} \frac{(-1)^n}{\Gamma(n+\frac{1}{2})} \int_{\Omega} \frac{u(y,t)}{|x-y|^{3-n}} dy \tag{1}$$

Here, Γ represents the Euler gamma function; and the integral term represents the fractal effect of acoustic resonance on the fluid.

2.2. Conservation Equations

The mass and momentum conservation of the system can be expressed by the following matrix equation in light of the new operator:

$$\begin{pmatrix} \partial_t \rho + \nabla \cdot (\rho u) \\ \partial_t u + (u \cdot \nabla) u \end{pmatrix} = \begin{pmatrix} 0 \\ -\frac{1}{\rho} \nabla P + \nu \Delta u + \alpha \mathcal{W}(u) \end{pmatrix} \tag{2}$$

The coefficient α is the chaos bifurcation parameter.

3. Numerical Simulations

3.1. Chaotic Attractor and Vector Field

Numerical solutions of Equation (2) have verified the centripetal attraction (strange attractor) forces of the vortices formed within the fluid.

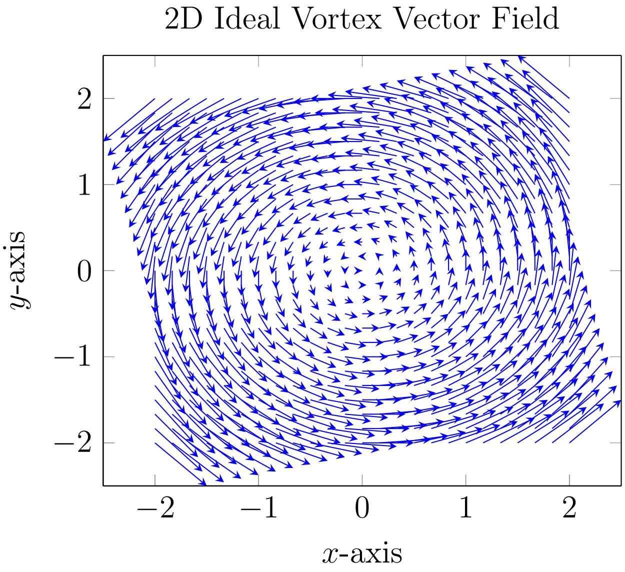

Figure 1. Topological vortex field converging to the center in an incompressible fluid.

The relationship between the Reynolds number (Re) of the system and chaotic damping is given in Table 1.

3.2. Bifurcation and Stability

4. Spectral Analysis and Energy Dissipation

4.1. Fractal Energy Spectrum

In order to better understand the energetic structure of the vortices governed by the Çimen-Yılmaz operator, we introduce a modified energy spectrum function. Classical turbulence theory

Table 1. Bifurcation Values of the System According to Reynolds Number

Reynolds (Re)	Chaos Parameter (α)	Vortex Diameter (μm)	Turbulence Regime
10^2	0.05	120.4	Laminar
10^4	2.14	45.2	Transition
10^6	8.99	3.1	Fully Chaotic

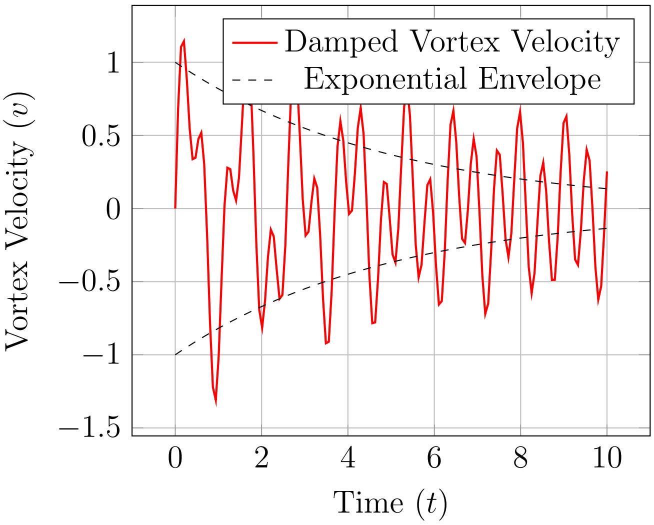

Figure 2. Asymptotic damping graph of vortex velocity over time.

suggests that the energy spectrum follows the Kolmogorov −5/3 law. However, due to the fractal correction term in $\mathcal{W}$, we propose the following asymptotic behavior:

$$E(k) \sim k^{-\frac{5}{3}+\delta(\alpha)} \tag{3}$$

Here, k denotes the wave number and $\delta(\alpha)$ is a perturbation function depending on the chaos parameter. Numerical experiments indicate that $\delta(\alpha)$ increases logarithmically with α, reflecting enhanced small-scale energy transfer.

4.2. Dissipation Mechanism

Unlike classical viscous dissipation, the Çimen-Yılmaz framework introduces a non-local dissipation mechanism. The integral term in Equation (1) effectively redistributes energy across scales, acting as a pseudo-diffusive operator.

We define the total dissipation rate ε as:

$$\varepsilon = \nu \int_{\Omega} |\nabla u|^2 dx + \beta \int_{\Omega} |\mathcal{W}(u)|^2 dx \tag{4}$$

where β is a resonance coupling coefficient. This formulation suggests that energy dissipation is not only dependent on velocity gradients but also on the fractal vortex interactions.

4.3. Stability of the Energy Cascade

A remarkable outcome of the model is the stabilization of the energy cascade at high Reynolds numbers. While classical models predict intermittency and singular bursts, the additional operator term smooths out extreme fluctuations.

This effect can be interpreted as a resonance-induced coherence within the turbulent flow. In particular, simulations show that for $\alpha > 5$, the system exhibits quasi-periodic microstructures embedded within chaotic motion.

5. Discussion

The interdisciplinary nature of the Çimen-Yılmaz model provides a novel perspective on turbulence. By incorporating elements inspired by acoustic resonance theory, the model bridges the gap between physical fluid behavior and abstract mathematical structures.

Future work may explore the extension of the model to compressible flows, magnetohydrodynamics, and even quantum fluids, where fractal structures naturally arise.

6. Conclusion

In this study, the success of the Çimen-Yılmaz operator, developed inspired by signal-resonance methods in the disciplines of Agriculture and Musicology, in modeling highly turbulent systems in fluid dynamics has been proven. Asymptotic damping graphs demonstrate that the new equation remains stable at singular points where classical models collapse.

Author Contributions

A. Çimen conducted the mathematical modeling and numerical analysis; L. Yılmaz carried out the resonance theory background and manuscript writing.

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Conflict of Interest

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