Experimenter's Guide – *Solving Navier-Stokes, Differently*

> **Context.** Clay Institute's €1 M Millennium Prize asks for a proof of existence / uniqueness. We take the *orthogonal* route: a **90-day, falsifiable protocol** that bets on **Narrative Ticks (NTs)** and their **distance-ratio rhythm** to beat DNS on lead-time, RMSE, and GPU cost.
>
> We look for **the instant disorder begins to order itself**. That flip-point is the NT. Repeating ratios of NT distances reveal the *fractal rhythm* nature prefers.

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1 · Motivation

Classical CFD hunts for **order → chaos** breakdown (shear layers, vortex shedding …). Our lens inverts it:

Classical lens	NT lens
Track a smooth solution until it blows up	Detect the **first DU flip** (NT) — *where disorder sprouts order*
Refine mesh / timestep	Study **successive NT-distance ratios** to expose hidden rhythm

Why ratios?

1. NT distances carry **scale-free memory**; their ratios cluster when the same physics repeats.
2. Over-lapping DU cycles still share the same ratio peaks — an invariant to test.

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2 · Scope & Prerequisites

- Python ≥ 3.9 • NumPy • h5py • matplotlib • Streamlit (see `requirements.txt`).
- HDF5 file with dataset `G_t` (drag, lift, KE …) — shape `(N,)`, uniform Δt — the same scalar used in the NT detection. `(N,)`, uniform Δt.
- **Binder sandbox** → Launch notebook (no install).

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3 · 10-Minute Smoke-Test

1. **Binder** → run `` — red dots mark candidate NTs.
2. Run `` — histogram should *not* be flat; look for sharp peaks.

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4 · Full 90-Day Benchmark

Phase	Days	Tool	Deliverable
Data preparation	0-10	`agents/nt_detect.py`	`nt_times.txt`
Initial ratio scan	11-15	`01_ratio_quicklook.ipynb`	Spiky histogram
Hyper-search σ	16-25	loop σ ∈ 1.0 – 2.0	σ* with strongest peaks
LES / ML run	26-80	Your solver	NT-aware forecast CSVs
KPI calculation	81-88	dashboard + CLI	`*_ratios.txt`, RMSE, GPU h
PR submission	89-90	GitHub	`results/<lab_tag>/…`

Target KPI lead-time ≥ 30 % • RMSE ≤ 5 % • GPU ≤ ½ DNS

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5 · Local Quick-Start

```
# clone & env
git clone https://github.com/gradient-pulse/phi-mesh.git
cd phi-mesh/RGP_NS_prototype
python -m venv .venv && source .venv/bin/activate
pip install -r requirements.txt

# 1 Detect NTs
python agents/nt_detect.py data/example_G.h5 --sigma 1.5

# 2 Ratio histogram quick-look
jupyter lab notebooks/01_ratio_quicklook.ipynb   # or use Binder
```

Batch Mode (CLI)

```
# Detect Narrative Ticks
python agents/nt_detect.py path/to/G_t.h5 --sigma 1.5

# Distance-ratio analysis (writes *_ratios.txt)
python agents/nt_ratio_cli.py nt_times.txt \
       --outdir results/ratios_run --sigma 1.5
```

❖ PoLA × NT Convergence — why the ratios matter

The **Principle of Least Action (PoLA)** is normally phrased as *"nature minimises action along a path."* In **RGP** that law appears as a **minimal-divergence rhythm**:

> **Narrative Ticks (NTs)** mark the instant a flow chooses the *least disruptive* pivot to stay coherent. Over many flips, the **ratios between successive NT distances** expose the rhythm that minimises unnecessary gradient drift.

Classical PoLA	RGP / NT lens
Minimise $\int L\,dt$ along a path	Minimise *recursive tension* between NTs
"Path of least action"	"Rhythm of least divergence"

Implication for experimenters → If your NT-distance histogram stabilises around the same ratio peaks across runs, you're watching PoLA express itself inside turbulence.

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6 · FAQ (Quick Reference)

Question	Answer
σ choice?	Scan 1.0 – 2.0; pick the σ giving the clearest ratio peaks.
Over-lapping DU cycles?	Ratio signature survives; treat each NT as a cycle start.
Units?	Any scalar (`G(t)` in J, N …); ratios are dimension-less.
No PR access?	Zip `*_nt.txt`, `*_ratios.txt`, `kpi.csv` and email marcusvandererve@icloud.com; we'll merge for you.

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7 · Reference

van der Erve, M. (2025). *Solving Navier-Stokes, Differently: What It Takes* (V1.2). Zenodo. https://doi.org/10.5281/zenodo.15830659

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