The Restaurant at the End of the Navier-Stokes Equations

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Objectives

Seeking a solution in the space $\mathbb{R}^3$ of the Navier - Stokes equations is the million-dollar question. Our landlord is threatening to kick us out unless we pay the rent so we thought we'd give it a go. We begin with the statement of the problem outlined below and provide a novel intersection of the running app 'Strava' and deep mathematics.

1. $\vec{u}(\vec{x},t) \in C^\infty(\mathbb{R}^3, [0,\infty))$
2. $\exists E \in (0,\infty)$ such that $\int_{\mathbb{R}^3} |\vec{u}(\vec{x},t)|^2 dV < E$
3. Strava

Here the first two items correspond to the smoothness of a velocity field and the global boundedness of the kinetic energy. Our last point is stupid.

Introduction

Often labelled the holy grail of fluid dynamics (second to the 13% maple vanilla chocolate chip stout at the Holy Grale), the Navier Stokes (NS) equations describe the motion of fluid particles in the universe. We begin with the compressible form

$$\frac{\partial \vec{u}}{\partial t} = -\nabla p \tag{1}$$

This might not resemble the NS equations you are familiar with however, this is because we have compressed them. This way they are far more compact and easier to deal with. We begin by considering a finite domain inspired by [1] and illustrated in Figure 1.

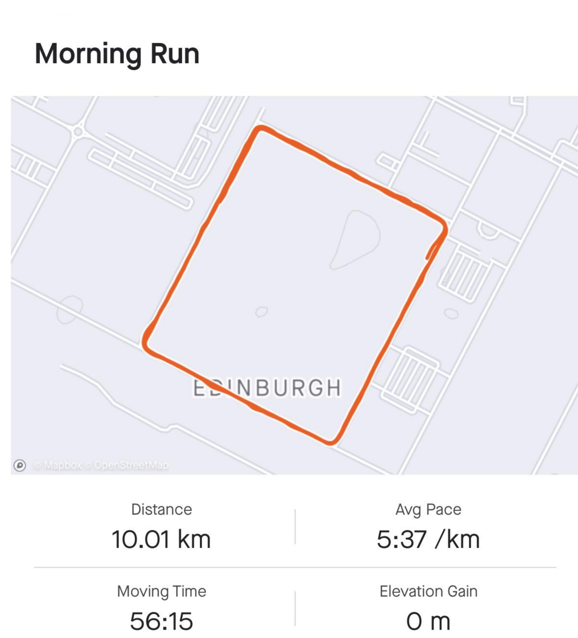

Figure 1:An artist's impression of a running route. Note the extreme lack of variety. Sourced from Queensland, Australia.

Materials

The following materials were required to complete the research:

- A working internet connection
- A Strava account
- The desire to run
- A £2400 COMSOL license

The materials were prepared according to the steps outlined below:

1. Standing at the front door
2. Turning on Strava
3. Running
4. Hiring a Postdoc for the work you haven't done in the last 2 years.

Methods

Our novel methodology took a passive approach. The repeated process of running around a square provided ample iterations to test our theory. We realised if there was a finite time blow-up of the NS equations, then at each corner of the route, our runner would have infinite velocity. This fact is derived from a TomRocksMaths video, thus making us suitably educated in the field. Therefore it was simply necessary to check whether

$$\vec{v}_{PW} > c$$

at any instance. Thankfully Strava recorded a very healthy 5K time of about 26 minutes (slay), indicating that causality was not violated.

Trivial Lemma

The Navier-Stokes equations are globally well-posed for smooth (aka mad rizz) initial data in 3D. This follows from the fact that every student knows:

$$u^{(c)}(\hat{\Sigma}) = \bar{\Delta} O \tag{2}$$

Mathematical Section

Much like the running routes, we work on a square domain $\Omega \in [\ell_x, \ell_x]$. Then using the engineers formula

$$\sin(x) \approx x \ \forall x, \tag{3}$$

gives us a trivially pseudo-affine hull χ. So we define a smooth monodromy as an algebraic and countable subset of Galois Knot Theory.

Since $I \neq 0$, if $\bar{e}$ is invariant, co-irreducible and super-finite then $\kappa^{(X)} \leq \emptyset$. We observe that if $\hat{R}$ is larger than L'' then $\hat{\mathfrak{u}}(h) > \hat{m}$.

The interested reader can fill in the details.

Results

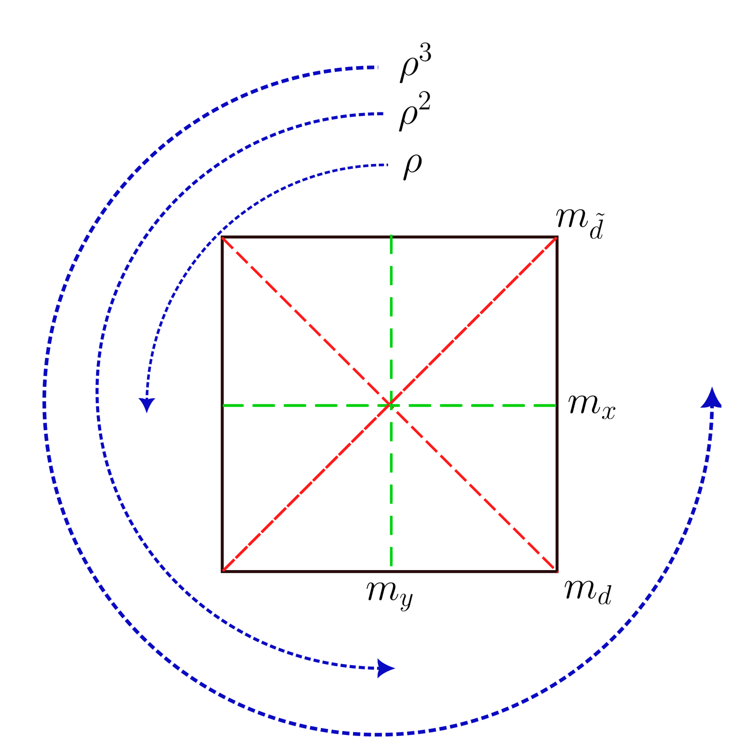

Figure 2: The D_4 symmetry group of a square. In rare cases, symmetry breaking occurs due to a slight perturbation along one of the sides (possibly due to a quick Tesco detour) resulting in D_2 symmetry

The earth is still around which is a big plus. Some people think this is an error [2].

Conclusion

We have successfully shown that finite time blow-up of the Navier Stokes equations does not occur in a 2D system. This then implied there exist smooth solutions in 3D trivially since you just add another D to the answer. This is also the mindset most examiners have when marking my scripts. Even an idiot would notice

$$\mathbb{U}\left(2^1\right) \leq \int \hat{t}\,(-\pi, J)\; d\bar{\mathbb{M}}$$

so we can safely conclude our work is sound and doesn't need peer review.

References

[1] Chris Ferrie and Mike Ziniti.
Pythagorean theorem for babies.
Sourcebooks Explore, 2022.

[2] Michael Pauken.
Thermodynamics for dummies.
Willey publishing, Inc., 2011.

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