KI und das Navier-Stokes-Problem

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تاریخ انتشار: 14 Mehr 2585 باستانی برابر با October 6, 2026 میلادی



A Comprehensive Review of Fluid Physics, Mathematical Challenges, and Scientific Controversies

Recent advancements in Artificial Intelligence have pushed the boundaries of computational science and pure mathematics in unprecedented ways. One of the most significant and controversial recent news items is the claim that an AI system from OpenAI has solved the Navier–Stokes equation, one of the complex mathematical puzzles known as the Millennium Prize Problems. This article closely examines the physical and mathematical nature of the Navier–Stokes equation, analyzing the challenges of "Singularity" and "Blow-up" in incompressible fluids. Furthermore, it explores the technical and computational dimensions of the AI model used, including the deployment of thousands of agents and the consumption of millions of tokens at astronomical costs. The event has also been accompanied by controversies, including accusations of plagiarism involving two mathematicians (one of whom was an employee of rival company Anthropic) and data privacy concerns. Finally, the article discusses the scientific community's reaction and the limitations of classical physics regarding these purely theoretical achievements.

The Intersection of Physics, Mathematics, and AI

At its most fundamental level, physics is an attempt to understand the laws of nature to predict the future. The basis for many of these predictions lies in differential equations that describe the behavior of material bodies. However, moving from solid bodies to fluids (liquids and gases) drastically increases the complexity of these equations. The Navier–Stokes equation, the beating heart of fluid mechanics, has preoccupied mathematicians and physicists for over a century. Recently, the claim that AI solved a major part of the Navier–Stokes puzzle has sparked waves of astonishment and criticism within scientific circles. This achievement is significant not only mathematically but also raises fundamental questions about the role of AI in future scientific .research, the boundaries of intellectual property, and commercial competition among tech giants

:Physical Foundations

From Newton's Second Law to Navier–Stokes

To grasp the magnitude of the Navier–Stokes problem, we must return to classical physics concepts. Newton's second law of motion (F = ma) states that the net force applied to an object equals its mass multiplied by its acceleration. For a "Solid Body," applying this law is straightforward. But fluids cannot be treated as a single cohesive mass. The Navier–Stokes equations are essentially F = ma expanded for a microscopic fluid element. The forces acting on :this tiny piece of fluid fall into three main categories

- **:Pressure Gradient Force**
- .Force from surrounding fluid molecules
- **:Viscosity Force**
- .Internal friction of the fluid, indicating resistance to flow
- **:External Forces**
- .Gravity or electromagnetic forces acting on the fluid volume
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The Challenge of Solving the Equations: Approximation vs. Absolute Precision

A key feature of the Navier–Stokes equation is the lack of an "Analytical Solution" for its general form. Engineers use "Numerical Methods" and supercomputers to divide the fluid volume into tiny grids. However, computational errors accumulate over long prediction times (the butterfly effect). .The Millennium Problem, however, is a purely abstract mathematical challenge

The Millennium Problem and the "Blow-up" Puzzle

In 2000, the Clay Mathematics Institute introduced seven unsolved mathematical problems, offering a $1 million prize for each. One was the Navier–Stokes existence and smoothness problem. The question: Is it possible in an incompressible fluid to start with a perfectly smooth flow and, within a finite time, reach a state where velocity becomes infinite at a specific point? ".This is known as a "Singularity" or "Blow-up

AI Giants Enter Pure Mathematics

OpenAI recently claimed its advanced internal models solved this problem for the case of an incompressible fluid under external forces. OpenAI reportedly used 1,000 AI Agents simultaneously, exchanging 2.7 million messages over 88 hours, consuming roughly 130 million tokens. Experts estimate the computational cost at around $20 million. The ultimate goal is not .(the $1 million prize, but proving dominance in the race toward Artificial General Intelligence (AGI

Controversies, Plagiarism Accusations, and Data Privacy

Just 12 hours before OpenAI's announcement, two mathematicians published a paper solving a simpler version of the problem using Euler Equations. OpenAI's approach closely resembled theirs. One mathematician worked for Anthropic, and both had used AI platforms like OpenAI's Codex for data analysis over the past two years, sparking theories that OpenAI accessed their .private prompts. OpenAI denied this, but the scientific community remains skeptical

Scientific Reaction and Classical Physics Limitations

Mathematicians have shown mixed reactions to a machine entering the sacred realm of pure mathematics. Furthermore, the Navier–Stokes equations belong to classical (Newtonian) physics. Assuming fluid velocity reaches infinity creates a physical paradox, as approaching the speed of .light requires Einstein's Special Relativity

Conclusion

Whether viewed as a stunning breakthrough or disguised plagiarism, this event is a historical turning point. Machines have entered the realm of abstract reasoning. The AI may have solved in

88 hours what stalled humans for a century, but the human mind still provides the ultimate meaning to these discoveries.