NEWSLETTER

of the Work Group Mathematical Fluid Mechanics

Newsletter no. 11 (2026)

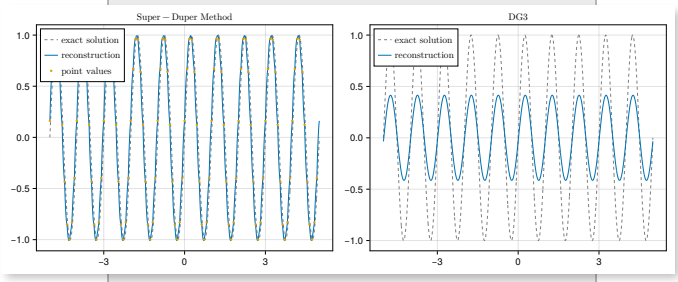
News about a paper

Paper w. Simon Krotsch accepted

The paper Christian Klingenberg, *Christian Klingenberg, Simon Krotsch, Phil Roe: "On Enhancing the Dissipative Behavior of Active Flux Advection Schemes", Lecture Notes in Computational Science and Engineering, Springer Verlag: Selected Papers from the ICOSAHOM 2025 Conference in Montreal (2026)* has been accepted for publication.

As explained *here*, discussions with Phil Roe toward the end of his life have led to this writeup. Clever modifications of a numerical scheme may lead to substantial improvements of the scheme, as exemplified in this paper.

This is Simon Krotsch's first publication.



The numerical simulation of the linear advection equation

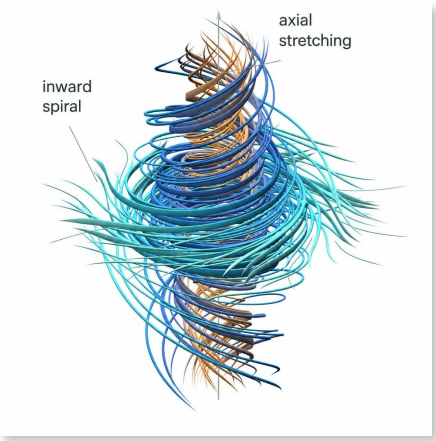
$$\frac{\partial}{\partial t}u(x,t)+\frac{\partial}{\partial x}u(x,t)=0$$

with oscillatory initial data is shown after a very long time. Whereas the 3^{rd} order discontinuous Galerkin method on the right shows quite some dissipation, the modified 3^{rd} order Active Flux method, suggested in the above paper (called the *super-duper* method), works well.

AI-agents, the open Navier-Stokes millennium problem and its implications

Artificial Intelligence (AI) agents purse goals with some autonomy. They are thus different from AI chatbots like ChatGPT. Recently swarms of AI agents have become very powerful.

A prominent mathematician in our field, *Tristan Buckmaster*, made me aware that mathematical ingenuity coupled with AI agents can solve serious math problems. Using this, he was on track to designing an example of a solution to the incompressible Navier-Stokes (N-S) equations that had blow-up after finite time, which would solve the so-called N-S millennium problem. The company OpenAI very recently jumped in, and (using vast computing resources with its AI agents) claims to have found this example last Tuesday, *see here*. The result has yet to be checked.



A figure by OpenAI: this 3-dim vortex, solving incompressible Navier-Stokes, will lead to a blow up of velocity.

Besides the joy that this problem will probably be solved, this story has other facets:

- *what role will AI play in mathematics in the future?*

AI is making significant strides in solving open mathematical problems and may potentially undermine the work of mathematicians. I believe that substantial progress in mathematics across various problem types will only be possible by leveraging mathematical ingenuity as a crucial component of the solution. In particular mathematicians excel in conceptual intuition in contrast to the superb ability of brute force calculations of AI agents.

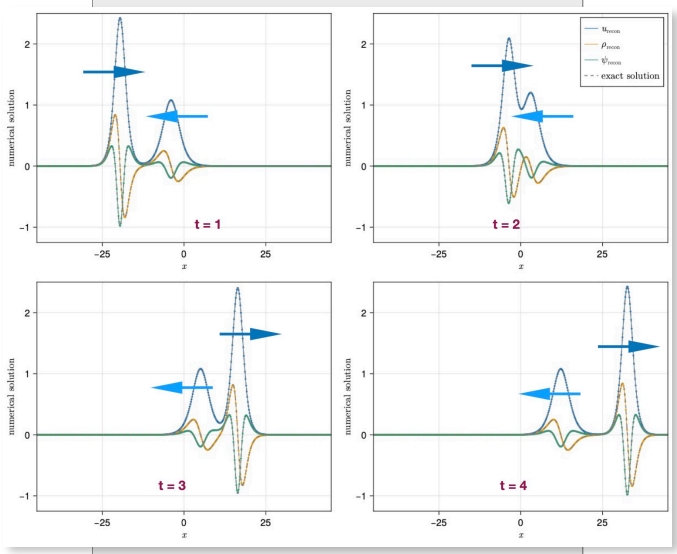
- *Outside of mathematics, AI agents are enormously capable.*

AI agents were able to discover exploits that compromise computer systems. This is just one of many concerning things AI agents will be able to do, raising worries about the potential consequences for humanity. - The potential danger posed by AI agents led this year's Fields medalist Jacob Tsimerman to take it so seriously that he left academia and now works on how to use mathematics for AI safety by founding the Mathematical AI Safety Institute. Clearly, we should all be vigilant.

Simon Krotsch submitted his Master thesis

Simon Krotsch submitted his Master thesis *Asymptotic preserving IMEX Active Flux schemes for a hyperbolic approximation of the Korteweg-de-Vries equation*.

Here the 3^{rd} order Korteweg-de-Vries equations is solved using an Active Flux scheme. Applying a numerical method designed for first order conservation laws to this non-linear PDE with a 3^{rd} oder derivative is successfully achieved here. This has not been done before and contains new ideas. The contents of this Master thesis will be submitted for a publication.



The numerical simulation of the Korteveg-de-Vries (KdV) equation

$$\frac{\partial}{\partial t}u(x,t)+u(x,t)\frac{\partial}{\partial x}u(x,t)+\frac{\partial^3}{\partial^3 x}u(x,t)=0$$

is shown at consecutive times. Two traveling waves (indicated by the blue arrows) run towards each other and after interacting they run away from each other and keep their shape. This is a typical for 'soliton' solutions of KdV.

New *reading club* on the theory of multi-dim. Euler equations

We are now running a *reading club* via Zoom on measure valued solutions of the multi-dim. Euler equations. Current active participants are

- Horimoto Kotaro (Japan)
- Julius Krotsch
- Sophie Lauer

with Nadine Braxmaier-Even and Nikhil Manoj listening in.

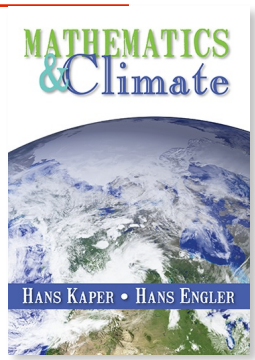
All are welcome to join, just write to me.

Upcoming scientific conferences

Click on the links and check where you might want to participate.

- Sept. 28 - Oct. 2, **2026**: *Numerical Methods for the Kinetic Equations of Plasma Physics* (NumKin 2026) in Bochum (Germany) organized by Eric Sonnendrücker and Katharina Kormann
- Feb. 22 – 26 , **2027**: *SIAM Conference on Computational Science and Engineering (SCE27)*, in Pittsburgh, Penn., USA.
- March 12 - 15, 2027: *24th IACM (International Association for Computational Mechanics) Computational Fluids Conference* in Yokohama, Japan
- May 17 - 19, 2027: *Phil Roe Symposium,* in Ann Arbor, Mich. USA, organized by Karthik Duraisamy, myself and others
- June 20 - 25, 2027: *Numerical Methods for Hyperbolic Problems (NumHyp 2027)*, in Verona 2027 organized by Elena Gaburro
- July 5 - 9, 2027: *International Conference on Spectral and High-Order Methods* (ICOSAHOM 2027), in Milan organized by Marco Verani, Paola Antonietti and others
- July 12 – 16, 2027: *11th International Congress on Industrial and Applied Mathematics (ICIAM)*, in The Hague, The Netherland

News about a new Bachelor thesis student



Franka Saak begins her Bachelor thesis with us

Franka Saak's interest in applying mathematics to further our understanding of man made climate change will lead to a Bachelor thesis studying various climate models.

News about conferences

IACM Computational Fluids Conference 2027

The *24th IACM (International Association for Computational Mechanics) Computational Fluids Conference* will be held 12 - 15 March 2027 in Yokohama, Japan. It covers broad spectrum of computational fluid dynamics.

NumKin 2026

The *Numerical Methods for the Kinetic Equations of Plasma Physics* (organized by Sonnendrücker et. al.) now has a list of speakers, *see here*.