NEWSLETTER

of the Work Group Mathematical Fluid Mechanics

Newsletter no. 3 (2025)

## News about submitted theses:
Kathrin submitted her PhD thesis

Kathrin Hellmuth submitted her PhD thesis *On qualitative experimental design for PDE parameter identification inverse problems*.

In order to infer unknown coefficients of a PDE model from measured experiments (that correspond to the PDE model) one wants to identify the proper experiments to achieve this. The coefficients are then found numerically. Sketching methods are suggested that propose experiments which make this algorithm efficient. – This thesis brings a fresh viewpoint to inverse problems for PDE parameter identification.

Melissa Lange submitted her Master thesis

Melissa Lange submitted her Master thesis *Optimal transport for seismic inverse problems*.

One tries to infer the geological layers below ground from sending waves through the ground and measuring them after they have passed through and having been reflected from the layers. Here the numerical algorithm to achieve this uses techniques from optimal transport.

Source *Receivers*
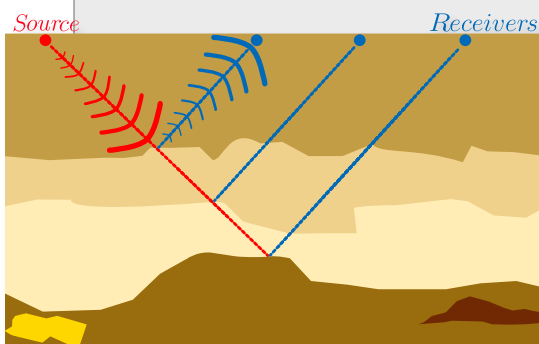
Kathrin Hellmuth will be a von Karman instructor

*Kathrin Hellmuth* will be a postdoc at Caltech, *see here*. The news is that she has been offered a *von Karman postdoctoral instructorship* at Caltech. For a postdoc position after the PhD in our broader field of applied mathematics this is one of the most prestigious positions one can attain. This can be gauged for example by listing previous recipients of the Caltech von Karman position (and their position following the von Karman instructorship):

- Eitan Tadmor (professor at Tel-Aviv University, Israel),
- Qin Li (tenure track professor at the Univ. of Wisc. in Madison, USA),
- Franca Hoffmann (tenure track professor at Caltech).

Kathrin will begin at Caltech in May 2025. Her postdoc position there will be until August 2027. *Congratulations*, Kathrin!

Theodor von Karman
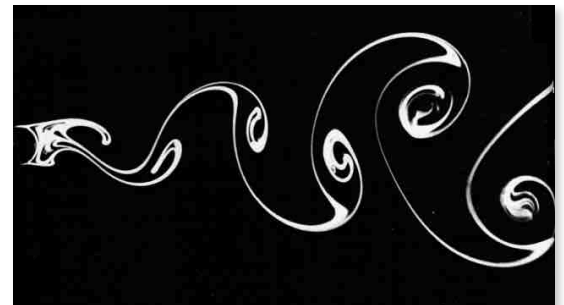
flow past a cylinder, the so called von Karman vortex street

On von Karman

Theodor von Karman obtained his PhD in 1908 in Göttingen from Ludwig Prandtl, who was associated with Courant, Hilbert and others at Göttingen University. Driven out of Germany by the rise of Nazism, von Karman went to Caltech in California and built up their *Jet Propulsion Laboratory* there.

In the spirit of Prandtl and the Göttingen school, von Karman's core scientific contributions were his use of mathematical tools to study fluid flow and interpreting these results to guide practical designs.

My research goal with our work group has always been to develop mathematical tools that can be useful in applications. I was influenced in this by my training at the Courant Institute in New York, working with researchers who themselves were students of Courant.

The top of this picture is the earth's surface. The picture itself itself is the ground below the earth's surface. On the earth's surface waves are triggered at the *Source*, which later arrive at the *Receivers*. From this information the layered structure of the earth can be deduced.

News about submitted papers:
Paper by Lisa Lechner and co-authors submitted

The paper *Wasilij Barsukow; Praveen Chandrashekar; Christian Klingenberg; Lisa Lechner: "A generalized Active Flux method of arbitrarily high order in two dimensions"* has been submitted to a journal.

This is the first paper that dedicates itself entirely to studying an arbitrary high-order Active Flux numerical scheme.
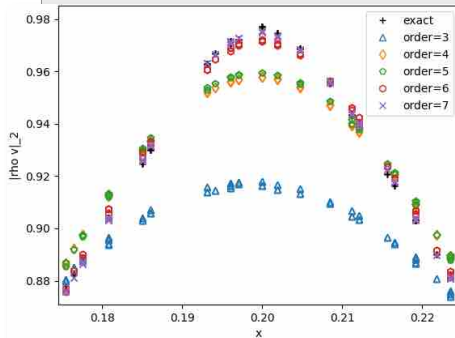
Active Flux computing the Gresho vortex for the 2-dim. Euler equations. A close up of a radial plot is shown. One sees that with increasing order the numerical solution improves.

Paper by Lena Baumann et.al. submitted

The article *Lena Baumann, Lukas Einkemmer, Christian Klingenberg, Jonas Kusch: "An energy stable and conservative multiplicative dynamical low-rank discretization for the Su-Olson problem"* has been submitted to a journal.

A reduction of computational cost for kinetic equations can be achieved by the *Dynamical Low-Rank* method. Its energy stability is studied here for the case that one uses a multiplicative splitting of the distribution function (which by itself reduces computational costs).

Paper with Marlies Pirner submitted

The article *Hongxu Chen, Christian Klingenberg, Marlies Pirner: "BGK model for rarefied gas in a bounded domain"* has been submitted.

Proving existence of solutions for kinetic equations is an active field of research. Here a bounded domain is considered. In case the solution initially is close to its global Maxwellian equilibrium, existence and convergence to the global equilibrium is proven. For the proof the nonlinearity of the collision term has to be carefully estimated.

Upcoming scientific conferences

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

- March 3 - 7, **2025**: *SIAM Conference on Computational Science and Engineering (CSE25)*, in Fort Worth, Texas, USA

- March 11- 13, 2025: *Synergies of Machine Learning and Numerics*, in Osaka, Japan, organized by Leon Bungert among others

- March 10 - 11, 2025: *Annual Meeting of the DFG Priority program on Hyperbolic equations*, in Darmstadt, organized by Jan Giesselmann and Martin Oberlack

- April 7 - 11, 2025: *Kinetic equations and turbulence* (Bardos' 85th birthday conference) in Gif-sur-Yvette (France, near Paris), organized by François Golse among others

- June 9 - 13, 2025: *Numerical methods for hyperbolic problems 2025* (NumHyp25), in Darmstadt, organized by Jan Giesselmann and others

- June 24 - 27, 2025: *30th Biennial Conference in Numerical Analysis* in Glasgow, organized by persons from the University of Strathclyde, Glasgow

- July 13 - 18, 2025: *International Conference on Spectral and High-Order Methods* (ICOSAHOM), in Montreal, Canada

- Sept. 1 - 5, 2025, *European Conference on Numerical Mathematics and Advanced Applications* (ENUMATH 2025) in Heidelberg, organized by Barbara Wohlmuth among others

- Sept. 14 - 20, 2025: *Hirschegg Workshop*, in the Kleinwalsertal, Austria, organized by Ferdinand Thein and Gerald Warnecke

- Sept. 24 - 26, 2025: Workshop on Hyperbolic Problems, in Nürnberg, organized by Emil Wiedemann and others

- November 17–20 , 2025: *SIAM Conference on Analysis of Partial Differential Equations* (PD25), Pittsburgh, Pennsylvania, USA

- sometime in **2026**: Finite Volume and Complex Applications 11, in Münster, Germany

- May 25 - 29, 2026: 20th International Conference on Hyperbolic Problems (HYP2026): Theory, Numerics and Applications, in Stuttgart, Germany organized by Maja Lukacova und Christian Rhode

News about upcoming visitors:
visit by Marlies next week

Marlies Pirner, who obtained her PhD with us, will visit us **Feb. 11 - 14**. On Thursday, Feb. 13, she will give a lecture, *see here*.

Praveen will visit in May

Praveen Chandrshekar will visit us **May 10 - June 1**. He has been a long term scientific collaborator of ours.

Maria Han-Veiga will visit

Maria Han-Veiga will visit us for the week **May 18 - 24**. In her research she studies both numerical methods for conservation laws and machine learning. She is the author of the book *The Mathematics of Machine Learning* that we used in our course.