Christian Klingenberg 22. September 2024

NEWSLETTER

of the Work Group Mathematical Fluid Mechanics

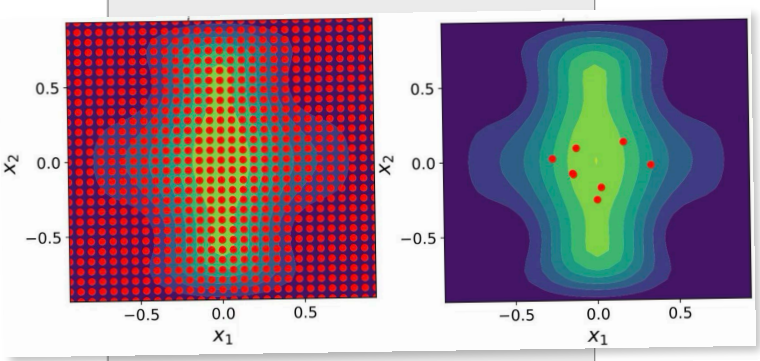
Newsletter no. 10 (2024)

Paper with Kathrin Hellmuth submitted

The paper *Kathrin Hellmuth, Christian Klingenberg, Qin Li: "Preserving positivity of Gauss-Newton Hessian through random sampling"* has been submitted.

Suppose we design an experiment that produces data for determining unknown parameters of a PDE that models the experiment. The numerical algorithm that determines the parameter is made efficient by a random sampling strategy for selecting the data. Also the experiment is made more efficient by this.

This is illustrated in the picture below. The PDE is the stationary Schrödinger equation $(-\Delta + p)u_p = 1$, where the unknown potential p is to be determined from measurements. In the left picture data is measured at all grid points (red dots). In the right picture our algorithm gives a numerically more efficient choice of data points (red dots), from which one can approximately determine the potential p.



An example of random sampling reducing the number of data points (fewer red dots on the right compared to the left) needed to determining an unknown parameter of a PDE

Jayesh Badwaik's PhD defense scheduled for Sept. 26

You can read about Jayesh Badwaik's PhD thesis in *this previous newsletter*.

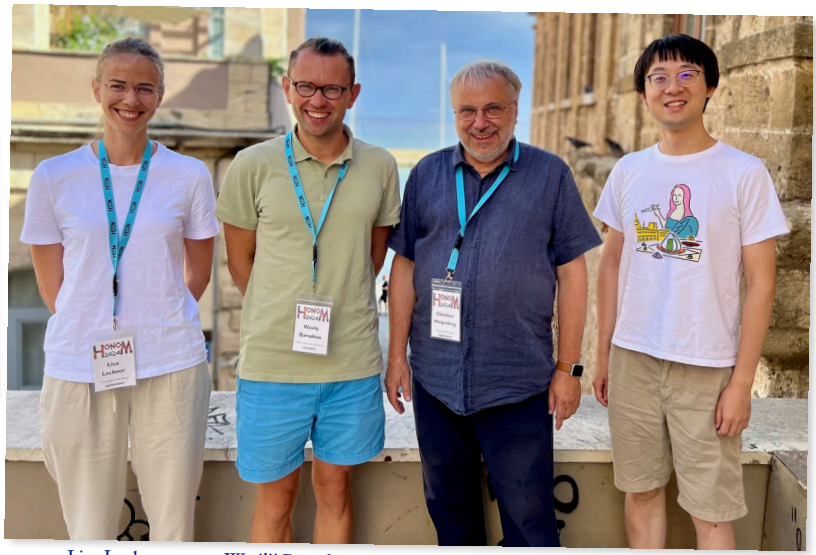
The reports for Jayesh Badwaik's PhD thesis are positive and have been accepted by the faculty of mathematics and informatics. His PhD defense is scheduled for Thursday, Sept. 26 at 2 pm in the Seminarraum of the Forschungsbau (Emil Fischer Str. 41). His examiners are Leon Bungert, *Yinhu Xia* (Heifei, China) and myself. Marlies Pirner will write the transcript of the exam.

Good luck, Jayesh!

Back from the HONOM 2024 conference

The conference on **H**igh-**O**rder **NO**nlinear numerical **M**ethods for evolutionary PDEs (HONOM) takes place every two years and focuses on numerics of conservation laws. Sept. 9 - 13, 2024 it took place in Crete, with Elena Gaburro organizing it.

Wasilij Barsukow, Junming Duan, Lisa Lechner and myself gave a sequence of consecutive plenary talks, where we explained our way of developing the Active Flux numerical method. This contributed to making this new approach better known in the scientific community.



Lisa Lechner Wasilij Barsukow myself Junming Duan
at HONOM 2024 in Chania, Crete

Marlies Pirner visits us this week

Marlies Pirner will visit us this week from Sept. 22 until Sept. 27. She has obtained her PhD with us. Her scientific work is on kinetic equations. Her office will be across from mine.

Hyunju Kwon speaks in our colloquium

Hyunju Kwon (ETH Zürich) will visit us Oct. 31. On that day she will give a colloquium talk at 2:15 pm (titled *The strong Onsager conjecture: a glimpse of turbulence*), instead of giving a lecture in our seminar.

Wasilij Barsukow plans to visit us

The week Nov. 3 - 8 Wasilij Barsukow will visit us. He has received his PhD with us. Scientifically he works on numerics of conservation laws. We have a project funded by the DFG (Lisa Lechner) and one by Humboldt (Junming Duan), where the four of us work on the Active Flux method. For an example see the simulation on the bottom right.

Kathrin Hellmuth lectures in Siegen

Kathrin Hellmuth will travel to the annual meeting of the German Inverse Problem Society (see here) Sept. 25 - 27 in Siegen, Germany, and will give a talk titled *Identifiability analysis for PDE parameter reconstruction*.

All the best, Kathrin!

Upcoming scientific conferences

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

- Sept. 25 - 27, 2024: Annual Meeting of the German-Speaking Inverse Problems Society 2024, in Siegen (Germany)

- Nov. 4 - 7, 2024: "Numerical Methods for the Kinetic Equations of Plasma Physics" in Garching, Germany, organized by Eric Sonnendrücker

- Dec. 16 - 20, 2024: 14th AIMS conference on differential equations, in Abi Dhabi, UAE, organized by the American Institute of Mathematical Sciences (AIMS)

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

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

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

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

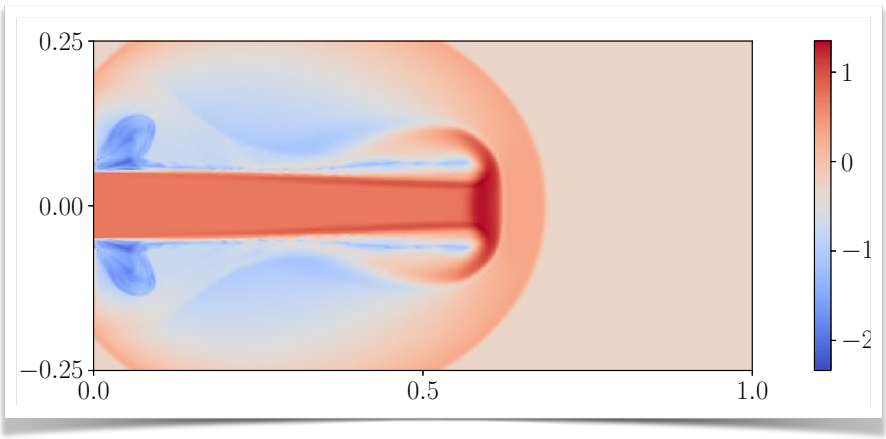
- fall of 2025: SIAM Conference on Analysis of Partial Differential Equations (PD25), somewhere in the USA

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

- 2nd half of July, 2026: 20th International Conference on Hyperbolic Problems: Theory, Numerics and Applications, in Stuttgart, Germany

HYP 2026 will take place in Germany

The next International Conference on Hyperbolic Problems, the main bi-yearly conference in the field of hyperbolic conservation laws, will be held in Stuttgart, Germany in the second half of July 2026. It will be organized by Maria Lukacova and Christian Rhode.



A 2-dim. numerical simulation of the compressible Euler equations using the Active Flux method (see here). We see the logarithm of density of a Mach 2000 jet impinging form the left.