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AGM² Digest

Analytical and Geometric Methods for Microstructure

#1 · November 2026

Hello everyone,

Welcome to the first issue of the AGM² Digest. Once a month I'll send a short list of things I've read or used and think you might enjoy, all loosely connected to analytical and geometric methods for microstructure: papers, code and tools, talks and upcoming events, job openings, and now and then something that doesn't fit anywhere else. Each item comes with a line or two on why I think it's worth a look, so the whole thing should take a few minutes to skim.

You're receiving this because you attended the 2026 edition of Advances in Ordered Fluids and Alignment Phenomena, or because you asked to be added to the list. If you'd rather not get it, you can unsubscribe with one click.

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Job openings

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- Hooke Research Fellow, Oxford
- Postdoc in GMT and geometric analysis, Milan
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One more thing

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Papers

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- A hybrid C^0-interior penalty method for the nematic Helmholtz–Korteweg equation
- Augmented Lagrangian preconditioning for a simplified Ericksen–Leslie model of nematic liquid crystals
- Tensor finite elements for smectic liquid crystals
- The Vicsek–Kuramoto model in collective dynamics: macroscopic equations and pattern formation
- Constrained dynamics for searching saddle points on embedded Riemannian submanifolds of Euclidean space

Talks & events

- Continuum Theory and Life Sciences — 60th Meeting of the Society for Natural Philosophy, University of Glasgow, 24–26 June 2026, organised by Ariel Ramírez Torres and Raimondo Penta. On the interface of continuum mechanics, applied mathematics and the life sciences, from cell mechanics and growth to tissue morphogenesis and the mechanics of biological materials. The keynotes included Apala Majumdar on nematic, smectic and cholesteric liquid crystal shells and Nigel Mottram on multi-layered active nematics. The meeting is over, but the programme and abstract booklet are online.
- Introduction to variational inequalities and their finite element solution — Ed Bueler (University of Alaska Fairbanks), Nelder Fellow lecture series at Imperial College London. Four lectures that start from the basics and build up to the extent of glaciation in a changing climate, ending with open problems on multigrid, adaptivity and well-posedness. The last two are on Tuesday 3 and Tuesday 17 November at 15:00 London time, in Huxley 658 and streamed on Zoom, and the lectures are being recorded.
- 26th GAMM Seminar on Microstructures — University of Freiburg, 12–13 November 2026, organised by Patrick Dondl. The annual meeting of the GAMM activity group on Analysis of Microstructures, on microstructures in solid mechanics, materials science and applied mathematics. Invited lectures by Francesco Mattesini, Thomas Speck and Elvira Zappale, with a Young Researchers' Minisymposium on the Thursday morning. Registration has closed, but the programme is online.
- Optimal transport in gradient flows and partial differential equations — Isaac Newton Institute, Cambridge, 25–29 January 2027, organised by David Bourne, Inwon Kim, Daniel Matthes and Filippo Santambrogio. A workshop on well-posedness, regularity and numerical approximation for PDEs with an optimal transport structure, from gradient flows to collective behaviour and chemotaxis. Applications have closed, but you can ask events@newton.ac.uk about availability.
- ENUMATH 2027 — the 16th European Conference on Numerical Mathematics and Advanced Applications now has its dates: 30 August to 3 September 2027 at the University of Padova. Minisymposium proposals are due 31 January 2027 and abstracts 2 April 2027.

- Nonlinear partial differential equations (analytic and geometric methods) — Isaac Newton Institute, Cambridge, 1 September to 10 December 2027, organised by José A. Carrillo, Panagiota Daskalopoulos, Manuel del Pino, Alessio Figalli, Henrik Shahgholian and Susanna Terracini. A programme on fully nonlinear elliptic equations, free boundaries, geometric flows, singularity formation and aggregation–diffusion equations, with three workshops: an introductory school (13–17 September), singularity formation (4–8 October) and free boundaries (6–10 December).

Job openings

- Postdoctoral Research Associate in numerical analysis and scientific computing — Brown University, Division of Applied Mathematics (METHODS group; contact: Brendan Keith). Two years from 1 July 2027, for a recent PhD with a background in finite element analysis and scientific software. Applications are considered from 15 November 2026.
- Hooke Research Fellow — Mathematical Institute, University of Oxford. Up to three years of independent research in applied mathematics, hosted by one of the applied groups (Numerical Analysis and OCIAM among them), with £3,000 a year for travel. The deadline is 17 November 2026 at 12:00 UK time.
- Postdoc in geometric measure theory and geometric analysis — Department of Mathematics “Federigo Enriques”, University of Milan, on the FIS 2 Starting Grant “SiGmA” led by Salvatore Stuvard. 18 months, extendable, from around 1 February 2027, on the regularity of minimal surfaces and their singular sets, weak mean curvature flows and related elliptic and parabolic PDEs, with no teaching duties. The deadline is 20 November 2026 at 11:59 Italian time.
- Tenure-track assistant professor (RTT) in mathematical analysis, type 1 — Department of Mathematical, Physical and Computer Sciences, University of Parma (MATH-03/A). A six-year contract with research in the calculus of variations, functional analysis or PDEs, and up to 120 hours a year of teaching in mathematical analysis or basic mathematics. Applications go through the PICA portal, with the CV in Italian. The deadline is 26 November 2026 at 23:59 Italian time.
- Tenure-track assistant professor (RTT) in mathematical analysis, type 2 — University of Parma: a separate call with the same profile, research, teaching and deadline as the one above.
- ERC postdoc in analysis — Bocconi University, Milan, in Elia Bruè’s group on the ERC project MIND (Mathematical Insights into Dynamics of Incompressible Turbulence). 24 months, renewable, from 1 September 2027, on the analysis of PDE models of incompressible turbulence; applicants with a background in physics, applied mathematics or numerical simulation of turbulence are encouraged too. No teaching duties. The deadline is 27 November 2026.
- Postdoc in geometric partial differential equations — University of Vienna, on Austrian Science Fund grants held

by Michael Eichmair, Thomas Körber and Daniele Semola. Two years of pure research in the geometric calculus of variations and PDEs, from isoperimetry in mathematical relativity to minimal surfaces and lower Ricci curvature bounds; cover letters should say how your work connects to theirs. The deadline is 30 November 2026.

- Postdoc on the manifold of embeddings — Chair of Harmonic Analysis, Chemnitz University of Technology, on the DFG project “The Manifold of Embeddings” (contact: Prof. Reiter). Two years, full-time and with no teaching, for someone with a background in geometric or numerical analysis or optimisation; knowledge of geometric curvature functionals, especially repulsive energies, is a plus. The deadline is 30 November 2026.
- Assistant Professor in Dynamical Systems — Department of Mathematics, Vrije Universiteit Amsterdam. For a mathematician working broadly in dynamical systems, from evolution equations, variational methods and pattern formation to rigorous numerics and data-driven approaches. The first contract is for 18 months and becomes permanent after a positive evaluation at the end of the first year. The deadline is 6 December 2026.
- Lecturer in Numerical Analysis & Data Science — Department of Mathematical Sciences, University of Bath. An open-ended post to build an independent research programme in computational mathematics and data science, alongside existing strengths in numerical linear algebra, machine learning and inverse problems. The closing date is 16 December 2026.
- PhD studentship: numerical modelling of anisotropic ice flow in West Antarctica — British Antarctic Survey and the University of St Andrews (IAPETUS), supervised by Clara Henry, Daniel Richards and Carlos Martín (BAS) and Tun Jan Young and David Rees Jones (St Andrews). 3.5 years on how ice fabric changes simulated flow and grounding-line dynamics, using finite elements in Firedrake. The deadline is 5 January 2027 at 12:00 GMT; international applicants need to contact the primary supervisor by 7 December 2026.
- Research assistant on the DOC-TWIN project — WIAS Berlin, Nonsmooth Variational Problems and Operator Equations group, a MATH+ project led by Prof. Hintermüller, Prof. Antil and Prof. Kaltenbach. Two years from 1 January 2027 on duality-based a posteriori error control and adaptive finite elements for PDE-constrained optimal control. Open until filled.

One more thing

- Society for Natural Philosophy — founded in 1963 by Clifford Truesdell to promote research on the unity of mathematical and physical science, mainly through small, selective meetings of mathematicians, physicists, chemists and engineers. Their annual conference came to the UK this year: the 60th meeting, on continuum theory and life sciences, was held in Glasgow on 24–26 June 2026. Thanks to Kaibo for the shoutout!
- INdAM research groups: membership for 2027 — applications to join the national research groups of the Istituto Nazionale di Alta Matematica are open until 26 November 2026 at 17:00 Italian time. The closest to this digest are GNCS (scientific computing), GNFM (mathematical physics) and GNAMPA (mathematical analysis, probability and their applications). Applications go through the PICA portal with your loginmiur credentials. If you're renewing, the form comes mostly pre-filled; first-time applicants need a letter of presentation (early-career researchers, from a supervisor, tutor or any group member) or a short letter of motivation (everyone else).

Papers

As this is the first issue, here are some papers on the topic that I've read recently and found interesting. From the next issue on, this section will only include papers I've read during the past month, or papers readers have asked me to announce: just reply to this email if you'd like one included.

- Modelling the three-dimensional, diagnostic fabric anisotropy field of an ice rise – A. Clara J. Henry, Carlos Martín and Reinhard Drews, Journal of Glaciology (2025). Simulates in three dimensions how the crystal fabric that makes ice anisotropic evolves across Derwael Ice Rise in Antarctica. What I didn't know is how the fabric is described: by the orientation tensor $\langle c \otimes c \rangle$ of the crystals' c-axes, averaged over the grains, which, once you subtract a third of the identity, is the same object as the Q-tensor used to describe nematic liquid crystals.
- A Kinetic Theory Approach To Ordered Fluids: Direct Simulation Monte Carlo Methods – José A. Carrillo, Patrick E. Farrell and Andrea Medaglia, arXiv (2026). A Monte Carlo method for fluids whose particles carry an order parameter, which captures the isotropic–nematic phase transition at the right temperature (videos).
- A hybrid C^0-interior penalty method for the nematic Helmholtz–Korteweg equation – Tim van Beeck, arXiv (2026). A finite element method for time-harmonic acoustic waves in nematic liquid crystals. The cool bit: this is the first solver for the nematic Helmholtz–Korteweg equation in three dimensions, something nobody had done before. Well done, Tim!
- Augmented Lagrangian preconditioning for a simplified Ericksen–Leslie model of nematic liquid crystals – Yanying Li, Xu Qian and Jingmin Xia, arXiv (2026). A block preconditioner for the coupled flow and director equations whose iteration counts stay nearly independent of the mesh.
- Tensor finite elements for smectic liquid crystals – Thomas Führer, Norbert Heuer and Torsten Linß, Mathematical Models and Methods in Applied Sciences (2026). A tensor-based finite element method for a smectic-A liquid crystal model. They build on a PRL paper by Xia, MacLachlan, Atherton and Farrell, taking advantage of the connection between smectic layers and shell theory, a connection I find very interesting. They only use the fact that the equations look similar, but I believe there is a deeper connection. Also,

mixed methods for this functional have already been developed by Farrell, Hamdan and MacLachlan.

- The Vicsek–Kuramoto model in collective dynamics: macroscopic equations and pattern formation — Sara Merino-Aceituno and Carmela Moschella, arXiv (2025). Derives kinetic and macroscopic equations for self-propelled agents that align both their direction of motion (Vicsek) and their angular velocity (Kuramoto), and compares the patterns they form, such as rotating clusters and travelling orientation waves.
- Constrained dynamics for searching saddle points on embedded Riemannian submanifolds of Euclidean space — Yukuan Hu and Laura Grazioli, arXiv (2026). Finds saddle points of an energy on a constraint manifold, such as a sphere, by following a flow that stays on it, discretised with forward Euler steps that are mapped back onto the manifold by a retraction. The point for us: to evolve a microstructure in time we need to respect its nature, for example by evolving the nematic director on S^2, or more generally on Capriz's order parameter manifold for a generic microstructure, so time integrators constrained to the manifold of the microstructure seem crucial for numerical methods.

Until next month,
Umberto

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