

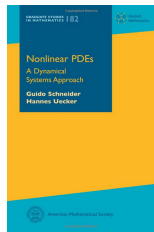
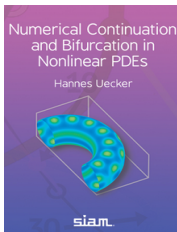
Hannes Uecker, Research

My research centers around the analysis of nonlinear PDE, mathematical modeling, and numerical simulation and bifurcation analysis. For an overview, my research can be arranged into six overlapping areas, with the more recent interests first.

1. Bifurcation and pattern formation in PDE systems over bounded domains, including numerical bifurcation analysis (pde2path), Classical and extended models from physics, chemistry and biology. [9, 12, 13,14,15, 16, 18, 20,22, 25,30,42,44, 43, 52,62, 65, 63, 71]
2. Development of pde2path. [76,19, 30, 31], see also the various pde2path tutorials
3. Pattern formation in infinite time–horizon optimal control with PDE constraints. [11, 17,22, 25]
4. Nonlinear Optics and related systems (NLS and other dispersive equation related problems). [23,24, 26, 27,28, 40,47, 51, 57,58,68,73, 61]
5. Fluid flow, in particular film flow with a free boundary over inclined planes. [45, 49, 59, 48, 55,53, 66, 69]
6. Pattern formation over unbounded domains (dissipative problems related to the Ginzburg–Landau equations and other modulation equation). [29, 79,33, 54,67,64, 74, 72,75]

Publications, last update 19. August 2024. Note: the linked preprints may differ slightly from the published versions.

Books



Numerical continuation and bifurcation in Nonlinear PDEs, SIAM, 2021, SIAM

Nonlinear PDEs: A Dynamical Systems Approach, AMS, Graduate Studies in Mathematics 182, 2017, mit Guido Schneider. AMS

Preprints

1. Traveling vegetation-herbivore waves can sustain ecosystems threatened by droughts and population growth, 2024, (mit J. Singha and E. Meron), preprint
2. Localized steady and oscillatory states near a Turing-Hopf instability in a semiconductor model, 2024, (mit F. Al Saadi, E. Knobloch and A. Meiners), preprint
3. Phase transition and minimal interfaces on manifolds with conical singularities, 2024, (mit D. Griesser, S. Held and B. Vertman), preprint

Peer reviewed journal publications and book chapters

2021–...

4. Numerical continuation and bifurcation for differential geometric PDEs, *NMTMA*, OA-2024-0005, 2024, (mit A. Meiners), preprint
5. Time-dependent localized patterns in a predator–prey model, *Chaos*, 34, 043143, 2024, (mit F. Al Saadi, E. Knobloch and M. Nelson), preprint

6. Nonlinear dynamics of modulated waves on graphene like quantum graphs, *Mathematische Nachrichten* 295 (11), 2147-2170, 2022, (mit S. Gilg and G. Schneider), preprint
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 8. Numerical continuation and bifurcation in Nonlinear PDEs - Algorithms, Applications, and Experiments, *Jahresbericht der DMV*, 2021.
 9. Localized and extended patterns in the cubic-quintic Swift-Hohenberg equation on a disk, *Phys. Rev. E*, 104:014208, 2021, (mit N. Verschuere and E. Knobloch) preprint
 10. Optimal spatial patterns in feeding, fishing, and pollution, *DCDS-S*, 2021, preprint
 11. Optimal Stock-Enhancement of a Spatially Distributed Renewable Resource, *Journal of Economic Dynamics & Control*, 123, 104060, 2021 (mit Th. Upmann, L. Hammann, B. Blasius)
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 13. Stripes on finite domains: Why the zigzag instability is only a partial story, *Chaos*, 30, 073104, 2020 (mit A. Shapira und A. Yochelis) preprint
 14. The role of spatial self-organization in the design of agroforestry system, *PLOS ONE*, 15:7, e0236325, 2020 (mit O. Tzuk und E. Meron) preprint
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 16. Defect-like structures and localized patterns in the cubic-quintic-septic Swift-Hohenberg equation, *PRE*, 100:1, 012204, 2019, (mit E. Knobloch und D. Wetzel) preprint
 17. Optimal fishery with Coastal Catch, *Natural Resource Modelling*, e12235, 2019 (mit D. Grass und Th. Upmann) preprint
 18. Continuation for thin film hydrodynamics and related scalar problems, in *Comput. Methods Appl. Sci.*, 50, Springer, Cham, 2019 (mit S. Engelnkemper, S. V. Gurevich, D. Wetzel and U. Thiele), preprint.
 19. Hopf bifurcation and time periodic orbits with pde2path - algorithms and applications, *Comm. in Comp. Phys.*, 2019, preprint, pde2path homepage.
(This replaces the old version (2016), where the algorithms, applications, and implementations were reviewed in a single document. Now the paper focusses on the algorithms and applications, while the implementation is reviewed in a Tutorial on Hopf bifurcation; see also pde2path tutorials.
 20. Mean field approach to first and second order phase transitions in ionic liquids, *PRE*, 95:060201, 2017, preprint, (mit S. Bier, N. Gavish and A. Yochelis)
 21. Desertification by Front Propagation?, *Journal of Theoretical Biology* 418 (2017), 27–35, (mit Y. Zelnik, U. Feudel und E. Meron) preprint
 22. Optimal management and spatial patterns in a distributed shallow lake model, 1:1-21, 2017, (mit D. Grass), preprint
 23. Low regularity justification results for envelope approximations of nonlinear wave packets in periodic media, *Asymptotic Analysis*, 99 (1-2), pp. 53-65, 2016 (mit K. Matthies), preprint

24. Sine-Gordon solitons in networks: Scattering and transmission at vertices, *Europ. Phys. Letters* 115: 50002, 2016 (mit Z. Sobirov, D. Babajanov, K. Nakamura and D. Matrasulov), preprint
25. Optimal control and spatial patterns in a semi arid vegetation system, *Natural Resource Modeling*, 29:2, 229–258, 2016, preprint
26. Bifurcation of Nonlinear Bloch Waves from the Spectrum in the Gross-Pitaevskii Equation, *Journal of Nonlinear Science*, 26:3, 581–618, 2016, (mit T. Dohnal), preprint

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27. Exact solutions of the Cauchy problem for the linearized KdV equation on metric star graphs, *Uzbek Mathematical J*, 2015:3, 143-154, (mit Z. Sobirov und M. Akhmedov), preprint
28. Soliton transport in tubular networks: transmission at vertices in the shrinking limit, *PRE* 91, 023209, 2015, (mit D. Grieser, Z. Sobirov, D. Babajanov and D. Matrasulov), preprint
29. Individual-based model for quorum sensing with background flow, *Bull. Math. Biology*, (mit J. Müller und B. Hense), 2014, preprint
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38. Local existence and uniqueness of solutions of the weak electrolyte model describing electroconvection in nematic liquid crystals. *ZAMM*, 91:3, 247-256, 2011 (mit W.-P. Düll und G. Schneider) preprint
39. Erratum to (published version of) 47, *Physica D*, 240, 357-362, 2011 (mit T. Dohnal)preprint
40. Interaction of modulated pulses in nonlinear oscillator chains, *J. Diff. Eq. Appl.*, 17:3, 279-298, 2011 (mit G. Schneider und M. Wand) preprint

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41. Amplitude equations – an invitation to multiple scale analysis *Summer School Modern Computational Science, Oldenburg 2010*, Universitätsverlag Oldenburg, 2010, preprint,

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Thesis

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- Rollen und modulierende Multipulse in musterbildenden Systemen, Dissertation, Universität Bayreuth, 2000. (siehe 75,74)
- Qualitative Theorie nichtlinearer partieller Differentialgleichungen der Mathematischen Physik, Habilitationsschrift, Universität Karlsruhe, 2004. (kumulativ, siehe 73–61, 54)

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