

## Dr. Hari Shankar Mahato

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### Personal Information

- Date of birth: 22.05.1986. Marital status: Married, one son & one daughter. Nationality: Indian

### Education

- **PhD, University of Bremen, 2013.** Supervisor: Prof. Dr. Michael Böhm.  
Thesis title: *Homogenization of a system of nonlinear multi-species diffusion-reaction equations in a  $W^{1,p}$  setting*
- **MSc in Mathematics, IIT Kharagpur, 2008**

### Research Areas

- PDEs, Applied Analysis, Optimal Control Problems, Homogenisation Theory, Multi phase flow.

### Current Employment

- Assistant Professor in the Department of Mathematics, IIT Kharagpur. February 2018 — Present

#### • Academic Responsibilities

- Teaching two full theory courses every semester (both Spring and Autumn semesters) to mathematics and engineering students. 8 - 9 Lecture hours/Week
- Supervision of Lab courses on Optimisation techniques, Mathematical Modeling, Object Oriented programming
- Have recently obtained three third party research grants
- Supervision as a Guide:
  - Completed: 1 PhD, 1 Postdoc. Ongoing: 3 PhDs
  - Currently supervising 7 undergraduate (Bachelor and Master thesis) students. Have supervised 20+ students on Bachelor and Master thesis
- Attending conferences, research visits both nationally and internationally. Recent visit to University of Erlangen-Nürnberg (Germany) and University of Bergen (Norway) from May till June 2023

#### • Administrative Responsibilities

- Faculty advisor for 5 years Mathematics & Computing students
- Assistant warden of an in-campus student hostel of 180 students who are studying at IIT Kharagpur
- Held the position of NSO Health & Fitness Sports officer for undergraduate students
- Co-incharge of the department time-table committee for lectures
- Member of the faculty recruitment committee and purchase committee
- Organised and co-organised several national and international conferences and meetings, guest visits and lectures in the department

### Past Employments

- Postdoc in the College of Engineering at University of Georgia from February 2016 — January 2018
- Offered a Postdoc position at the Federal University of São Carlos in September 2015 — Rejected
- Research associate in the Chair of Analysis at TU Dortmund from March — August 2015

- Offered a Postdoc position at the Forschungszentrum Jülich in March 2015 — Rejected
- Offered a research associate position at the University of Erlangen-Nürnberg in February 2015 — Rejected
- Offered a Postdoc position at the University of Kassel in August 2014 — Rejected
- Postdoc in the Chair of Applied Mathematics lead by Prof. Dr. Peter Knabner 1 at the University of Erlangen-Nürnberg from July 2013 to February 2015
- Worked as an associate software engineer from June 2<sup>nd</sup> 2008 to January 23<sup>rd</sup> 2009 at eRevMax Pvt. Ltd., Kolkata, India. Education

### Third Party Grants and Projects

- Received MATRICS Grant. Awarding agency: Department of Science & Technology, SERB India. Value: INR 600K (~ \$7500 or ~ €6800). Duration: February 2023 — January 2026. **Project title:** Phase Field Models and Mixture of Fluids in a Multiphase Porous Medium: Modelling, Analysis and Homogenisation Techniques
- Received Core Research Grant. Awarding agency: Department of Science & Technology, SERB India. Value: INR 2.7M (~ \$33000 or ~ €30500). Duration: March 2021 — February 2024. **Project title:** A System of Multi-Species Diffusion-Reaction Equations in a Heterogeneous Medium: Analysis, Homogenisation and Optimal Control Approach
- Received ISIRD Grant. Awarding agency: IIT Kharagpur. Value: INR 600K (~ \$7500 or ~ €6800). Duration: May 2019 — April 2022. **Project title:** Generalisation of homogenisation techniques for moving interface problems in heterogeneous mediums
- Multi-Scale Modeling of Scaffold Structures in Tissue Engineering. Submitted to NBHM India, 2022. Submitted for evaluation
- Submitted a project proposal to Humboldt Fellowship Foundation, Germany under the experienced researchers category, 2023
- Preparing project proposal for Fulbright Fellowship, USA under the visiting researcher category. To be submitted soon. Deadline: July 5th, 2023

### Awards and Honours

- Won the POEMS Travel Grant worth of £ 750 to visit University of Glasgow for two weeks
- Received funding for PhD at the University of Bremen
- Achieved highest *GPA* amongst 2 year M.Sc. Students (Mathematics) during 2006-2008
- Awarded twice for highest marks in *Graduation* from department of mathematics at SGB College, 2005-2006
- Received the joint award for the *best project* in M.Sc. in Mathematics

### Research Supervision & Mentorship

- PhD students: 4 (1 completed, 3 ongoing). Postdoc: 1. BSc, MSc, MTech students: 20+

### Teaching Experience

- Teaching several courses at Undergraduate and Postgraduate level (BSc, BTech, MSc, MTech) students. Courses: Analysis — I, Analysis — II, Integral Transform, Analytical Mechanics, Fluid Mechanics, PDEs, Integral Equations, Mathematical Modeling etc.
- Lab supervisor for the courses: Object Oriented Programming, Mathematical Modeling, Optimisation Techniques
- Worked as a Teaching Assistant from 2013 till 2018 during PhD and Postdoc

### Language Proficiency

- English - Native speaker. German - Fluent, B2 Level

## Leadership Roles

- Faculty Advisor for 5 years Maths & Computing Students from July 2018 — Present
- Recorded NPTEL Video lectures for UG students on Advanced Thoery of ODEs, Advanced Engineering Mathematics, Integral and Vector Calculus, and Partial Differential Equations - an initiative by Govt. of India, from 2019 — Present
- Assistant warden of a student hostel in campus from January 2022 — December 2023
- Department class time-table in-charge and seminar in-charge from July 2021 — Present
- NSO health & fitness program officer from July 2019 — June 2022
- Convenor of the “International Conference on Modeling, Analysis and Simulations of Multiscale Transport Phenomena” which is going to be held on August 25th — 27th, 2022
- Member of the organising team in the 83rd Annual Conference of Indian Mathematical Society 2019 in the Department of mathematics, IIT Kharagpur
- Member of the organising team in the International Conference on Applied and Computational Mathematics, 2018 in the Department of mathematics, IIT Kharagpur
- Member of the organising team for the mini symposium on the occasion of 60th birthday of Prof. Dr. Peter Knabner, July 2014
- Member of the organising team of the first kick-off meeting "Mini-Workshop Münster — Dortmund to wave propagation” between University of Münster and TU Dortmund, March 2015

## Conferences and Invited Talks

- Have attended and gave talk in more than 40+ scientific meetings such as conferences, seminars, invited talks in Germany, USA, India, Switzerland, UK, Norway, Czech Republic etc.

## Publications

### ■ Published/Accepted/In-press

22. A. Kundu, H.S Mahato. Homogenisation of an optimal control problem for multispecies diffusion-reaction equations. Revision submitted to *Journal of Dynamical and Control Systems*, 2024.
21. A. Kundu, H.S Mahato. An optimal control problem for diffusion-precipitation model" to the journal. Accepted in *Asymptotic Analysis*, 2024.
20. A. Kundu, **H.S. Mahato**. Existence of solution for an optimal control problem in a heterogeneous porous medium. *IMA Journal of Mathematical Control and Information*, pp. 1-28, 2024. DOI: 10.1093/imamci/dnae011.
19. N. Ghosh, **H.S. Mahato**. Corrector estimates and numerical simulations of a system of diffusion-reaction-dissolution-precipitation model in a porous medium. *Journal of Computational and Applied Mathematics*, Vol. 440, pp 1-17, 2023.
18. N. Lakhmara\*, **H.S. Mahato**. Homogenization of a strongly coupled in compressible Stokes-Cahn-Hilliard system modeling two-phase mixture in a porous medium. *International Conference on Mathematics and Computing*, ICMC 2022: Mathematics and Computing, pp 591–604, 2023.
17. N. Ghosh\*, **H.S. Mahato**, Pore Scale analysis and homogenization of a diffusion-reaction-dissolution-precipitation model. *International Conference on Mathematics and Computing*, ICMC 2022: Mathematics and Computing, pp 621-636, 2023.
16. **H.S. Mahato\***, G.P. Raja Sekhar. A Homogenization Approach to the Effect of Surfactant Concentration and Interfacial Slip on the Flow Past Viscous Drops. *Applicable Analysis*, 2022, DOI: 10.1080/00036811.2023.2168655.
15. **H.S. Mahato**, M. Eden. Homogenization of a poroelasticity model for fiber-reinforced hydrogels. *Mathematical Methods in the Applied Sciences*, 2022;1-19. doi:10.1002/mma.8466.

14. N. Lakhmara, **H.S. Mahato**. Homogenization of a coupled incompressible Stokes-Cahn-Hilliard system modeling binary fluid mixture in a porous medium. *Nonlinear Analysis*, Volume 222, pp 1-19, 2022.
13. N. Ghosh, **H.S. Mahato**. Diffusion-reaction-dissolution-precipitation model in a heterogeneous porous medium with nonidentical diffusion coefficients: analysis and homogenisation. *Asymptotic Analysis*, 1, pp 1-35, 2022.
12. **H.S. Mahato\***. Upscaling of evolving micro structures in a porous medium. *Physics of Fluids*, Vol. 30, no. 10, pp 1-15, 2020.
11. **H.S. Mahato\***, C. Ahlström, R. Jansson-Löfmark, U. Johansson, G. Helmlinger, M. Hallow. Mathematical model of hemodynamic mechanisms and consequences of glomerular hypertension in diabetic mice. *Nature Systems Biology and Applications*, Vol. 5, No. 2, 2018.
10. **H.S. Mahato\***, L. Banas. Homogenization of Cahn-Hilliard type equations in a perforated porous medium. *Asymptotic Analysis*, 105(1-2), pp. 77-95, (2017).
9. **H.S. Mahato\***. A note on extension type theorems in homogenization of periodic domains. *N-W European Journal of Mathematics*, Vol 3, pp 107–122, 2017.
8. **H.S. Mahato\***, M. Böhm, S. Kräutle, P. Knabner. Homogenization of a system of multi-species diffusion-reaction-dissolution-precipitation equations in the presence of inflow-outflow boundary conditions. *Advances in Mathematical Sciences and Applications*, Vol. 26, No. 1, pp 39–81, 2017.
7. **H.S. Mahato\***. Upscaling of Helmholtz equation originating in transmission through metallic gratings in meta-materials. *Book chapter in the Special Issue on Qualitative Theory of Differential Equations, Difference Equations, and Dynamic Equations on Time Scales*, 2016, DOI: <http://dx.doi.org/10.1155/2016/7436136>.
6. **H.S. Mahato\***. Numerical simulations for a two-scale model in a porous medium. *Numerical Analysis and Applications*. Springer Publication, Vol. 10, No. 1, 2017.
5. **H.S. Mahato**, N. Ray, R. Schulz, F. Frank, P. Knabner. Strong solvability up to clogging of an effective diffusion-precipitation model in an evolving porous medium. *European Journal of Applied Mathematics*, Cambridge University Press, pp 1 — 29, 2016. DOI: 10.1017/S0956792516000164.
4. **H.S. Mahato\***. Existence and averaging of a system of nonlinear parabolic equations with mixed Neumann-Robin interface conditions. *Advances and Applications in Fluid Mechanics*, 19 (2), pp 473 - 488, 2016. DOI: <http://dx.doi.org/10.17654/FM019020473>.
3. **H.S. Mahato\*** and M. Böhm. An existence result for a system of coupled semilinear diffusion-reaction equations with flux boundary conditions. *European Journal of Applied Mathematics*, Cambridge University Press, pp 1 — 22, 2014. Doi:10.1017/S0956792514000369.
2. **H.S. Mahato\***, M. Böhm. Homogenization of a system of semilinear diffusion-reaction equations in an  $H^1$  setting. *Electronic Journal of Differential Equations*, Vol. 2013 (2013), No. 210, pp 1 — 22.
1. **H.S. Mahato\***, M. Böhm. Global existence and uniqueness of a system of nonlinear multi-species diffusion-reaction equations in the presence of homogeneous Neumann boundary conditions in an  $H^1$  setting. *Journal of Applied Analysis and Computation*, Vol. 3, No. 4, pp 357 — 376, 2013.

■ **Submitted for review**

1. N. Ghosh, H.S Mahato. Global existence and uniform boundedness of the classical solutions for the system of multi-species transport with mass control. Submitted to *Studies in Applied Mathematics*, 2023.
2. N. Lakhmara, H.S. Mahato. A micro-scale diffused interface model with Flory-Huggins logarithmic potential in a porous medium. Submitted to *Physica D: Nonlinear Phenomena*, 2023.

3. H.S. Mahato. Role of RAAS pathways and SGLT2 co-transporters in Diabetic Nephropathy: Mathematical modeling of disease progression and responses to different drug therapies. NPJ Complexity, 2023.
4. A. Kundu, H.S. Mahato. Rigorous homogenisation of an optimal control Problem for multispecies diffusion-reaction equations. Submitted to Studies in Applied Mathematics. 2022.
5. N. Ghosh, H.S. Mahato. Existence of solution and homogenisation of a coupled system of semilinear parabolic equations with nonlinear multivalued ordinary differential equation. Submitted to Annales scientifiques de l'École normale supérieure, 2023.
6. H.S. Mahato. Global solution for a system of multispecies diffusion-reaction equations with distinct diffusion coefficients. Submitted to Topological Methods in Nonlinear Analysis, 2023.
7. N. Lakhmara, H.S. Mahato. Numerical Validation for a Stokes-Cahn–Hilliard System in a Porous Medium. Submitted to Applied Mathematics and Computation, 2023.

■ **Books & Edited Volumes**

1. H. S. Mahato, P.V.S.N. Murthy. An Application Based Treatise to Fluid Mechanics. Under preparation.
2. H.S. Mahato, S. Bhattacharyya. Proceedings of International Conference on Modeling, Analysis and Simulations of Multiscale Transport Phenomena, August 25th - 27th, 2022. Under preparation.

Hari Shankar Mahato

Kharagpur, 08.04.24

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