Rishabh P. Sharma

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RESEARCH INTERESTS

Self-organization, Pattern formation, Growth processes, Fluid dynamics, Porous medium, Multiphase flows, Soft-matter physics

EDUCATION

2020 – present **University of Warsaw, Poland**
Ph.D. in Physics; *Advisors:* Prof. Piotr Szymczak and Prof. Mariusz Białecki
Title: **Self-organization of flow in dissolving rocks**
I have developed an integrated approach that combines theoretical and computational modelling with 4D X-ray images of a porous rock to study dissolution patterns in rock samples. I have also developed image analysis tools to extract the structure of the dissolution patterns from dissolution experiments.

2015 – 2017 **Thapar University, India**
M.E. in Thermal Engineering; *Advisor:* Prof. Neeraj Kumar
Title: **Nodal integral method for convection-diffusion transport in complex domain using linear and higher order quadrilateral qlements**

2010 – 2014 **Uttar Pradesh Technical University, India**
B.Tech. in Mechanical Engineering

RESEARCH EXPERIENCE

2021 – 2024 **Research team member, Faculty of Physics, University of Warsaw** in a project, developing computational models to study dissolution patterns in unsaturated medium

2018 – 2021 **Research team member, Institute of Geophysics, Polish Academy of Sciences**, in a project modelling dissolution patterns in saturated medium with Darcy models media

Feb-Oct, 2018 **Project Tech. Asst., Dept. of Energy Sciences. IIT Bombay** in a project modelling the propagation of non-linear ultrasonic waves in tumers

2017 – 2018 **Project Res. Assc., Dept. of Aerospace Engg., IIT Bombay** in a project investigating particulate flows using CFD-DEM modelling approach

AWARDS/FUNDING

2024 IDUB University research microgrant to attend a physics school
2024 IDUB University support for completion of doctoral dissertation
2023 IDUB University research microgrant to attend a physics school
2023 Early Career Scientist's Travel Support Award by European Geophysical Union
2022 Uni. Integrated Development Programme (ZIP) travel support for a research visit
2021– Scientific scholarship in a project funded by National Science Centre
2020– Interdisciplinary doctoral school scholarship
2020 SEG Student Chapter, Field Camp-2020, IGF-PAN
2018 Scientific scholarship in a project funded by National Science Centre
2015 Graduate Scholarship, Ministry of Education, Government of India
2010 University Scholarship for Merit-Incentive Students
2010 Bronze Medal in Programming Diploma by NCVT, Government of India
2006 11^{th} position in Pioneer 7^{th} science competition

JOURNAL ARTICLES

1. Cooper, M. P., **Sharma, R. P.**, S. Magni, T. P. Blach, A. P. Radlinski, K. Drabik, A. Tengattini, and P. Szymczak (May 2023). 4D tomography reveals a complex relationship between wormhole advancement and permeability variation in dissolving rocks. *Advances in Water Resources* **175**, 104407.
2. **Sharma, R. P.**, M. Białecki, M. P. Cooper, A. P. Radliński, and P. Szymczak (June 2023). Pore merging and flow focusing: Comparative study of undissolved and karstified limestone based on microtomography. *Chemical Geology* **627**, 121397.
3. **Sharma, R. P.**, J. Deng, P. K. Kang, and P. Szymczak (Oct. 2023b). Effects of Mixing at Pore Intersections on Large-Scale Dissolution Patterns and Solute Transport. *Geophysical Research Letters* **50**(21).
4. **Sharma, R. P.** and N. Kumar (2018b). Nodal integral method for convection-diffusion transport using linear and higher order quadrilateral elements. *Numerical Heat Transfer, Part B: Fundamentals* **74**(3), 623–645.

CONFERENCE PROCEEDINGS

1. **Sharma, R. P.** and N. Kumar (2018a). Nodal integral method for complex geometries using higher order elements. In: *Proceedings of the 24th National and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2017)*. Begellhouse.

CONFERENCE PRESENTATIONS

1. Dzikowski, M., P. Szymczak, and **Sharma, R. P.** (2023). Empowering pre-exascale computers for Darcy-Brinkman simulation of wormhole growth based on X-CT data-can we recover experiments? In: EGU23-739.
2. **Sharma, R. P.**, P. K. Kang, and P. Szymczak (May 2023). Effects of mixing at pore intersections on large-scale dissolution patterns. In: *EGU General Assembly 2023, Vienna, Austria*, EGU-275, pp.EGU–275.
3. Białecki, M., **Sharma, R. P.**, M. P. Cooper, and P. Szymczak (May 2022). Comparative study of undissolved and karstified limestone based on microtomography. In: *EGU General Assembly 2022, Vienna, Austria*, EGU22-5229, pp.EGU22–5229.
4. Lipar, M., P. Szymczak, R. Ciglič, **Sharma, R. P.**, M. Zorn, U. Stepišnik, and M. Ferk (May 2022). Challenges in characterisation and mapping of solution pipes. In: *EGU General Assembly 2022, Vienna, Austria*, EGU22-1619, pp.EGU22–1619.
5. **Sharma, R. P.** and P. Szymczak (2021). "Network modelling of wormholing process in rocks". DREAMS21 Workshop, University of Paris Diderot, Laboratoire Mati'ere et Syst'emes Complexe.
6. Szymczak, P., M. P. Cooper, S. Magni, **Sharma, R. P.**, T. P. Blach, A. P. Radlinski, M. Dohnalik, and A. Tengattini (Apr. 2021). Wormhole Growth in Dissolving Limestones: Insights from 4D Tomography. In: *EGU General Assembly 2021, Vienna, Austria*, EGU21-13883, pp.EGU21–13883.
7. **Sharma, R. P.**, M. Cooper, A. J. C. Ladd, and P. Szymczak (2020). "Flowfield study in dissolved porous media". University of Wrocław, Institute of Theoretical Physics CFD Wroclaw-7 workshop, Wrocław, Poland.
8. Szymczak, P., M. P. Cooper, S. Magni, **Sharma, R. P.**, T. P. Blach, A. P. Radlinski, M. Dohnalik, and A. Tengattini (Dec. 2020). Combined Neutron and X-ray Time-Resolved Tomography of Wormhole Growth in Dissolving Limestones. In: *AGU Fall Meeting*. Vol. 2020, H081-01, pp.H081–01.

POSTERS

1. **Sharma, R. P.**, J. Deng, P. K. Kang, and P. Szymczak (2024). "Effects of mixing at pore intersections on large-scale dissolution patterns and solute transport". 6th Cargese summer school: FLOW and Transport in porous and fractured Media (FLOWTIME), Cargese, France.
2. Deng, J., **Sharma, R. P.**, P. Szymczak, and P. K. Kang (Dec. 2023). Anomalous Transport through Dissolving Fracture Networks. In: *AGU Fall Meeting 2023, San Francisco, CA*. Vol. 2023, H12D-04, pp.H12D–04.
3. Dzikowski, M., **Sharma, R. P.**, and P. Szymczak (2023). "High-resolution Darcy-Brinkman simulation of wormhole growth based on X-CT data". InterPore-2023, Edinburg, Scotland.
4. **Sharma, R. P.**, M. Białecki, and P. Szymczak (2023). "How does chemical erosion change the pore structure of a rock?" Geilo School 2022-The Physics of Evolving Matter: Memory, Learning and Evolution, Geilo, Norway.
5. **Sharma, R. P.**, M. Cooper, and P. Szymczak (2023). "Geometric measures of wormholes in dissolving rocks". Geilo School 2023-The Physics of Evolving Matter Continued: Connectivity, Communication and Growth, Geilo, Norway.

6. Cooper, M. P., **Sharma, R. P.**, S. Magni, P. N. H. Vu, T. Ladd, A. P. Radlinski, T. P. Blach, K. Drabik, A. Tengattini, and P. Szymczak (Dec. 2022). Competition Between Wormholes in Dissolving Rocks Captured with 4D Tomography and Numerical models. In: *AGU Fall Meeting*. Vol. 2022, H52N-0635, pp.H52N–0635.
7. Dzikowski, M., P. Szymczak, and **Sharma, R. P.** (Dec. 2022). Large Scale Simulations of Wormhole Growth in Dissolving Porous Media using Lattice Boltzmann Method. In: *AGU Fall Meeting*. Vol. 2022, H52N-0644, pp.H52N–0644.
8. **Sharma, R. P.**, P. K. Kang, and P. Szymczak (2022). "The impact of intersection mixing rules on the network-scale dissolution patterns". 7th Warsaw School of Statistical Physics, Sandomierz, Poland.
9. **Sharma, R. P.**, M. P. Cooper, A. J. C. Ladd, and P. Szymczak (Apr. 2021). Subpixel determination of wormhole tip position in 4D tomography of dissolving limestone cores. In: *EGU General Assembly 2021, Vienna, Austria*, EGU21-14962, pp.EGU21–14962.
10. **Sharma, R. P.**, M. P. Cooper, A. J. C. Ladd, and P. Szymczak (May 2020). Modeling wormhole formation in digital rock samples: the role of segmentation and permeability-porosity relationships. In: *EGU General Assembly 2020, Vienna, Austria*. EGU General Assembly Conference, 996, pp.996.
11. Cooper, M. P., S. Magni, **Sharma, R. P.**, P. N. Vu, T. P. Blach, A. P. Radlinski, M. Dohnalik, A. Tengattini, A. Ladd, and P. Szymczak (2019). Determining the influence of pore-scale geometry on wormhole formation. In: *AGU Fall Meeting*. Vol. 2019, pp.H21M–1931.

TALKS/SEMINARS

1. **Sharma, R. P.**, M. Cooper, and P. Szymczak (2021a). "Fractal shapes in dissolving rocks". Symposium of young scientist (SMN2021), University of Warsaw.
2. **Sharma, R. P.**, M. Cooper, and P. Szymczak (2021b). "Study of dissolution channels and their geometrical properties using XCMT images". Looping Network Meeting, University of Paris Diderot, Paris, France.
3. **Sharma, R. P.**, M. Cooper, and P. Szymczak (2021c). "Study of geometrical measures of wormholes using 4D-tomography". University of Warsaw, Department of Complex Modelling Complex system seminar, Nov-2021.
4. **Sharma, R. P.**, M. Cooper, and P. Szymczak (2021d). "Study of geometrical measures of wormholes using 4D-tomography". University of Warsaw, Faculty of Physics Soft matter and statistical Physics seminar, Nov-2021.

TECHNICAL SKILLS

Programming Languages: C, C++, Python, Fortran
Computing: OpenFOAM, Matlab, Mathematica

TEACHING

Graduate Teaching Assistant

Fall, 2023 Hydrodynamics and Elasticity
Spring, 2022 Geophysical Laboratory-II

Student Team Project Supervisor

Spring, 2022 Study of the hydrodynamic properties of a mixture of ground coffee and water
Spring, 2024 Introduction to OpenFOAM

REFERENCES

Prof. Piotr Szymczak
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Prof. Anthony Ladd
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