Rupeng Li

✉ *rupeng.li@outlook.com*
rupengli.github.io
Google Scholar Profile

Current Position

2022-Present **Lecturer**, ***C**hina **U**niversity of **P**etroleum (**B**eijing), China.*

Education

2017–2022 **PhD, Petroleum Engineering**, *The **U**niversity of **N**ew **S**outh **W**ales, Australia*,
- Supervisor: Christoph Arns, Igor Shikhov
- Research focus: Bayesian optimization, inverse problems, NMR for porous media.

2013–2017 **BEng, Petroleum Engineering**, ***C**hina **U**niversity of **P**etroleum (**E**ast China)*,
- GPA – 3.94/4.00, Ranking 1/432
- Exchange student at UNSW, Spring 2017.

Research Interests

I am interested in building efficient and scalable probabilistic models for inverse problems arising from parameter estimation in core analysis, groundwater management, etc, where the optimal parameter is derived when the perfect match between experiments and expensive black-box simulations is achieved. Currently, I focus on developing practical multi-objective Bayesian optimization approaches to the estimation of key physical parameters under various physical constraints.

Publications

Journal Articles

2022 **Bayesian optimization with transfer learning: A study on spatial variability of rock properties using NMR relaxometry**
Rupeng Li, Igor Shikhov, and Christoph Arns
Water Resources Research, top journal in hydrology [AGU]

2022 **A Bayesian optimization approach to the simultaneous extraction of intrinsic physical parameters from T_1 and T_2 relaxation responses**
Rupeng Li, Igor Shikhov, and Christoph Arns
SPE Journal, #1 in petroleum engineering [OnePetro]

2022 **Tuning the intentional corona of cerium oxide nanoparticles to promote angiogenesis via fibroblast growth factor 2 signalling**
Lu Fu, **Rupeng Li**, Whitelock John, and Megan Lord
Regenerative Biomaterials [OUP]

2021 **Solving multiphysics, multiparameter, multi-modal inverse problems: an application to NMR relaxation in porous media**
Rupeng Li, Igor Shikhov, and Christoph Arns
Physical Review Applied [APS]

2021 **Mechanisms of confining pressure dependence of resistivity index for tight sandstones by digital core analysis**
Hongyi Dai, Igor Shikhov, **Rupeng Li**, and Christoph Arns
SPE Journal [OnePetro]

2021 **A numerical study of field strength and clay morphology impact on NMR transverse relaxation in sandstones**
Yingzhi Cui, Igor Shikhov, **Rupeng Li**, Shitao Liu, and Christoph Arns
Journal of Petroleum Science and Engineering [Elsevier]

2020 **A topology-based single-pool decomposition framework for large-scale global optimization**
Xiaoming Xue, Kai Zhang, **Rupeng Li**, Liming Zhang, Chuanjin Yao, Jian Wang, and Jun Yao
Applied Soft Computing [Elsevier]

2018 **Relaxation and relaxation exchange NMR to characterise asphaltene adsorption and wettability dynamics in siliceous systems**
Igor Shikhov, **Rupeng Li**, and Christoph Arns
Fuel [Elsevier]

Working Papers

In Print **Practical multi-objective Bayesian optimization algorithms for removing adverse effect from the internal magnetic field for NMR measurement of saturated porous media**
Rupeng Li, Igor Shikhov, and Christoph Arns
• Low-field NMR is a quick and reliable tool for estimating hydrological and geophysical properties. However, reservoirs with high concentrations of iron will incur high internal magnetic fields (Bi field) making logging data simply unexplainable. Current approaches require careful calibration and are extremely time-consuming. We propose a Bayesian approach to estimate unknown rock, fluid properties, together with mineral magnetic susceptibilities. However, estimating around ten physical quantities of interest can lead to a complex, unstable inverse problem with multiple solution sets. We propose a practical multi-objective Bayesian optimization approach to mitigate the unwanted effect from the Bi field while incorporating additional physical constraints reducing the number of feasible solution sets.

In Print **Surface relaxivity as a function of temperature: Estimation and prediction of dynamically-changing surface properties of porous media using multi-objective Bayesian optimization**
Rupeng Li, Igor Shikhov, and Christoph Arns
• The temperature-dependent surface relaxivity behavior in sandstone rocks is not well understood. Surface relaxivities as well as effective relaxation times vary with temperature whereas the formation factor does not. Instead of minimizing the sum of the three objectives, we regard the three objectives as competing and seek to find the approximate Pareto front by minimizing the expected hypervolume improvement. In addition, we use multi-task Gaussian processes to exploit the inter-task correlations providing a higher speed of convergence and fewer solution sets due to lower uncertainty compared with independent Gaussian processes neglecting the output correlation as well as by aggregating to a single-task optimization problem.

In Print **On the choice of the regularization parameter for NMR T_2 inversion**
Rupeng Li, Igor Shikhov, and Christoph Arns
• NMR core analysts are always confronted with choosing the best regularization parameter for inversion of NMR T_2 decays into T_2 distributions, balancing the informativeness and smoothness of T_2 distributions. However, there is no unified method that performs well under various situations. We propose a self-explaining approach to the selection of the best regularization parameter leveraging the additiveness of the independent Gaussian noise making a significant contribution to the unbiased explanation of the NMR data in both laboratory and down-hole environment.

Conference Proceedings

2023 **A Bayesian optimization approach to the extraction of intrinsic physical parameters from T2 relaxation response**
Rupeng Li, Igor Shikhov, and Christoph Arns
International Symposium of the Society of Core Analysts, Austin, Texas [E3S]

2017 **T_2-store-T_2 Relaxation Exchange NMR to Characterize Effect of Asphaltenes on Wettability Dynamics in Siliceous Systems**
Igor Shikhov, **Rupeng Li**, and Christoph Arns
International Symposium of the Society of Core Analysts, Vienna, Austria [jgmaas]

Talks

2022 **A Bayesian optimization approach to the extraction of intrinsic physical parameters from T_2 relaxation responses**
Rupeng Li, Igor Shikhov, and Christoph Arns
Oral presentation at the 36th International Symposium of the Society of Core Analysts (SCA), Austin, Texas

2022 **Determination of intrinsic physical properties of porous media by solving inverse problems in Laplace NMR relaxometry using Bayesian optimization**
Rupeng Li, Igor Shikhov, and Christoph Arns
Poster presentation at the 15th International Bologna Conference on Magnetic Resonance in Porous Media (MRPM), Hangzhou, China

2020 **Effective parameter identification via NMR experiment and simulation using multi-task inverse solution workflow**
Rupeng Li, Igor Shikhov, and Christoph Arns
Oral presentation at the 12nd Annual Meeting of Interpore, Qingdao, China

2019 **Identification of surface relaxivities and effective diffusion coefficients governing relaxation processes in porous media by matching T_2 distributions through Bayesian optimization**
Rupeng Li, Igor Shikhov, and Christoph Arns
Oral presentation at the 12nd Australia and New Zealand society for Magnetic Resonance conference (ANZMAG), Perth, Australia

2019 **Identification of physical properties governing relaxation process in saturated rocks by matching experimental T_2 distributions and CT-image based NMR simulation through SL-particle swarm optimization**
Rupeng Li, Igor Shikhov, and Christoph Arns
Poster presentation at the 5th International Conference on Magnetic Resonance Microscopy (ICMRM), Paris, France

2018 **Accelerated simulation of NMR T_1 relaxation in digitized porous media using first-passage equations**
Rupeng Li, Igor Shikhov, and Christoph Arns
Poster presentation at the 8th Biennial Western Sydney University Symposium on NMR, MRI and Diffusion, Sydney, Australia

Teaching

2023-Present Lecturer, Undergraduate Physics (II)
- Prepared and delivered physics to a large class of 124 students

2023-Present Lecturer, Physics Experiments (II)
- Created and delivered physical experiments: principle and application of oscilloscope; viscosity measurement; determination of wavelength of light using Newton's rings, etc

2022 Teaching Assistant, Undergraduate Physics (II)

2022 Teaching Assistant, Physics Experiments (II)

2018-2020 Teaching Assistant, PTRL3030 & PTRL5021, Reservoir Characterization
- Created and delivered simple and ordinary Kriging interpolation, stochastic simulation, up-scaling and their applications in geological modeling.

Grants and Awards

2022-2024 Early-Career Researcher Award
- *Geological parameter estimation using Bayesian optimization*
- 500 researchers per year for oversea degree recipients

2022 Poster Presentation Award at the 15th International Bologna Conference on Magnetic Resonance in Porous Media

2018 Poster Presentation Award at the 8th NMR, MRI & Diffusion Symposium

2017-2022 UNSW Doctorate Scholarship

2016 4th place in SPE Asia Pacific Oil & Gas Conference and Exhibition Paper Contest

2016 Exchange Student Scholarship, UNSW & Chinese Scholarship Council

2014-2016 National Scholarship - 1/432, awarded 3 years in a role, CUPE

Programming skills

Intermediate Python, Bash, C, Fortran

Experienced MATLAB