

Mohammad Javad Shojaei, PhD – Curriculum Vitae

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Education

- **PhD**, Chemical Engineering and Analytical Science, The University of Manchester, 2016-2020
- **M.Sc.**, Chemical Engineering, Sharif University of Technology, Tehran, 2011-2013
- **B.Sc.**, Chemical and Petroleum Engineering, Sharif University of Technology, Tehran, 2007- 2011

Professional Experiences

- **Postdoctoral Researcher**, Imperial College London, London, Oct 2023-present

My research employs synchrotron X-ray tomography and advanced image processing techniques, including convolutional neural networks, to investigate the intricate dynamics of battery performance. Specifically, we concentrate on the evolution of pore space at micro-resolution and cathode thickness at macro-resolution during the charging and discharging cycles of a battery. Our findings will illuminate the nuanced interplay between micro and macro phenomena within battery systems, providing valuable guidance for future advancements in battery design and performance optimization.

- **Postdoctoral Researcher**, Newcastle University, Oct 2022-Oct 2023

In this role, I have developed a novel and comprehensive image registration framework in Python to register different pairs of imaging modalities, including Hematoxylin and Eosin (H&E), Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS), Imaging Mass Cytometry (IMC), and Spatial Transcriptomics (ST) images. I also utilize various software tools such as Qupath, NDP, MCD Viewer, and GeoMx to open and preprocess these distinct imaging modalities. This framework enables the integration of diverse imaging modalities and provides a deeper understanding of the tissue.

- **KTP Research Associate**, Queen Mary University and Carl Zeiss Microscopy, Mar-Oct 2022

My research involved culturing live cells and conducting live-cell imaging, followed by image analysis. I cultured cells under various drug treatments and performed imaging using a live-cell imaging microscope (Applied Precision, Delta Vision Core) to track cell division from metaphase to anaphase. Subsequently, I developed a Python-based image processing pipeline for kinetochore detection, segmentation, pairing, and temporal tracking.

- **Postdoctoral Researcher**, Imperial College London, London, Sep 2020-Feb 2022

My research focused on using high-resolution X-ray tomography and deep learning methods to characterise multiphase flow in gas diffusion layers to optimise fuel cell performance and investigating two-phase flow steady-state in sandstone rock, particularly focused on mixed wet systems. To conduct my experiments, I employed both the HeliScan Micro-CT and ZEISS Xradia 510 Versa imaging systems, and Scanning Electron Microscope (SEM) and effectively processed the acquired data using Python for advanced analysis. During my tenure, I successfully completed two projects, and my research led to the publication of two impactful papers, and I currently have two additional manuscripts under review.

- **Postdoctoral Researcher**, The University of Manchester, Manchester, Nov 2019- Aug2020

Within this project, I successfully conducted a comprehensive investigation into the stability and performance of emulsion solutions in both bulk and pore-scale environments. Despite the challenges posed by the COVID-19 pandemic, I successfully completed the project within the allocated timeframe. Leveraging sophisticated microfluidics and advanced imaging systems, I carried out

optical micromodel experiments and performed rheological experiments to gain valuable insights into emulsion behavior. To analyze and interpret the data, I employed Python, and Fiji for precise image processing of optical images from the micromodel.

- **Research Assistant**, The University of Manchester, Manchester, 2019

My research project focused on studying soil salinisation for sustainable agriculture, funded by N8 AgriFood, UK. The main objective was to gain a fundamental understanding of the mechanisms governing solute transport and deposition in single capillary tubes, essential for describing saline water evaporation and solute precipitation in complex porous media. To achieve this, we employed dual-energy imaging through synchrotron X-ray micro-tomography to investigate solute transport and deposition during evaporation. Throughout the project, I analyzed extensive X-ray data sets using IDL software and a customized MATLAB code to calculate salt evaporation from capillary tubes with varying shapes and sizes.

- **Lecturer**, Islamic Azad University South Tehran Branch, Tehran, Iran (2014).

I designed both Reservoir Engineering and Fluid Property courses from scratch for classes of 50 students. I had weekly classes and regular meetings with the students to answer their questions.

- **Research Engineer**, Researchers at EOR Research Institute, Tehran, Iran 2013-2015

My job focused on the simulation of oil production under different scenarios using the Prosper Software Package for South Pars Oil Reservoir.

Supervision of Master's Students

Azuan Zainudin (UOM, 2017-2018), Mostafa Mostafa (UOM, 2017-2018), Yangyu Zhang (UOM, 2017-2018), Fatima Alqallaf (UOM, 2017-2018), Cyan Yang (Newcastle University, 2022-2023)

I designed their projects, assisted them in completing their tasks, and presented their findings in a written dissertation format.

Skills

- Proficient in Python Programming, Data Analysis, Quantitative Analytics, Deep Learning, Image Processing, Image Registration, Project Planning, Research Support
- Skilled in Micro-CT Imaging, Optical Microscopy, Live-Cell Microscopy, Scanning Electron Microscopy, Soft Matter, Material Science, Material Characterization, Foam, Surfactants, Nanoparticles, Surface Chemistry, Microfluidic Systems, Laboratory Equipment, Laboratory Skills, Laboratory Safety.

Honors & Awards

- I received a Global Talent Visa with an unrestricted work permit in the UK.
- Recipient of President's Doctoral Scholar (PDS) Award at The University of Manchester
- The PDS Award is given to the most outstanding students from across the UK and globally, who have the commitment and capability to work on challenging research projects in world-leading research environments.
- Ranked 8th in National Entrance Exam for MS, among more than 3000 participants, February 2012.
- Ranked 75th in National Entrance Exam for BS, among more than 200000 participants, July 2007.
- Ranked 1st in High School Graduation among 300 students.

Published And Peer-Reviewed Journal Papers

1. Eslamimanesh, A.H. Mohammadi, Y. Salamat, **Shojaei M.J.**, S. Eskandari, and D. Richon, Phase Behavior of Mixture of Supercritical CO₂ + Ionic Liquid: Thermodynamic Consistency Test of Experimental Data, *AIChE Journal*, 59(10), October 2013.
2. Ghanavati, M., **Shojaei, M.J.**, and Ramazani Saadat Abadia, A., Effects of Asphaltene Content and Temperature on Viscosity of Iranian Heavy Crude Oil: Experimental and Modeling Study, *Energy & Fuels*, 27(12), November 2013.
3. Keshavarzi, B., **Shojaei, M.J.**, Ghazanfari, M.H., and Ghotbi, C., An Estimation of Wave Attenuation Factor in Ultrasonic Assisted Gravity Drainage Process, *Iranian Journal of Oil & Gas Science and Technology*, 3(1), Winter 2014.
4. **Shojaei, M.J.**, Bahrami, E, Barati, P, Riahi, S. Adaptive neuro-fuzzy approach for reservoir oil bubble point pressure estimation, *Journal of Natural Gas Science and Engineering* Volume 20, September 2014, Pages 214–220 Volume 20, September 2014, Pages 214–220.
5. **Shojaei, M.J.**, M.H. Ghazanfari, and M. Masihi, Relative Permeability and Capillary Pressure Curves for Low Salinity Water Flooding in Sandstone Rocks, *Journal of Natural Gas Science and Engineering*, Volume 25, P 30-38, July 2015.
6. **Shojaei. M.J.**, K. Osei-Bonsu, P. Grassia, and N. Shokri* (2018), Foam Flow Investigation in 3D-Printed Porous Media: Fingering and Gravitational Effects, *Ind. Eng. Chem. Res.*, 57, 21, 7275-7281.
7. **Shojaei. M.J.**, K. Osei-Bonsu, S. Richman¹, P. Grassia, and N. Shokri, Foam stability influenced by displaced fluids and by the pore size of porous media, *Ind. Eng. Chem. Res.*, DOI: 10.1021/acs.iecr.8b05265.
8. **Shojaei. M.J.**, Rodríguez de Castro, K. A., Méheus, Y., and. Shokri, N., Dynamics of foam flow in a rock fracture: Effects of aperture variation on apparent shear viscosity and bubble morphology, *Journal of Colloid and Interface Science*, DOI: 10.1016/j.jcis.2019.05.068.
9. **Shojaei. M.J.**, Osman, A., Méheus, Y, Grassia, P, Shokri, N., Combined Effects of Nanoparticles and Surfactants upon Foam Stability, *Chemical Engineering Science Journal*, DOI: <https://doi.org/10.1016/j.ces.2021.116601>
10. **Shojaei. M.J.**, Kiani, S., Barron, AR., Alexander S, N. Shokri, Foam generation and stability: Role of surfactant structure and particle aggregates, *Ind. Eng. Chem. Res.*, doi.org/10.1021/acs.iecr.1c03450.
11. **Shojaei. M.J.**, Dani Or, N. Shokri, Localised delivery of liquid fertiliser in coarse textured soils using foam as carrier, *Transport in Porous Media*, DOI 10.1007/s11242-022-01820-5
12. **Shojaei. M.J.**, Vahid J Niasar, Stability and rheology behaviour of emulsion in bulk and microfluidic system, Under review in *Energy & Fuel*.
13. SMS. Shokri-Kuehni, **Shojaei. M.J.**, N. Shokri, Dynamics of solute transport in capillary tubes delineated by dual energy imaging, Under review in *Transport in Porous Media*.
14. **Shojaei. M.J.**, N. Lane, B. Rashid, B. Bijeljic, M.J. Blunt Use of high-resolution x-ray imaging with pore-scale determination of wettability to validate pore-scale models, Under review in *Scientific Reports - Nature*.
15. **Shojaei. M.J.**, B. Bijeljic, Y. Zhang, M.J. Blunt, Minimal surfaces in porous materials: X-ray imaging to quantify contact angle and curvature in gas diffusion layers to design optimal performance of fuel cells, *ACS Applied Materials & Interfaces*, <https://doi.org/10.1021/acsam.2c00023>.
16. Mahdaviara, M, **Shojaei. M.J.**, Siavashi, J, Sharifi, M, Blunt M.J., Deep Learning Application for X-ray Image Segmentation in Gas Diffusion Layers, *Journal of Fuel*,

<http://dx.doi.org/10.1016/j.fuel.2023.128180>.

17. **Shojaei. M.J.**, Liua, C.P, Blunt, M.J, Zenyuka, Estimating Water Contact Angles of Gas Diffusion Layers Using Curvature and Topology from Micro X-ray Computed Tomography, Journal of Fuel Cell, Under review.
18. Siavashi, J, **Shojaei. M.J.**, Mahdaviara, M, Sharifi, M, Blunt M.J, Segmentation of Two-Phase Flow X-ray Tomography Images to Determine Contact Angle Using Deep Autoencoders, Applied Soft Computing Journal, Under review.
19. **Shojaei. M.J.**, B. Bijeljic, M.J. Blunt, X-Ray Tomography Dataset of Steady-State Two-Phase Flow in Bentheimer Sandstone, Digital Rocks Portal, <https://www.digitalrockportal.org/projects/471>.
20. **Shojaei. M.J.**, B. Bijeljic, M.J. Blunt, X-ray tomography dataset of gas diffusion layers with different coating percentages along with their corresponding segmented images, Digital Rocks Portal, <https://www.digitalrockportal.org/projects/462>.
21. Hosseinpour. M; **Shojaei. M.J.**; Salimi. M; Amidpour. M, Machine learning in absorption-based post-combustion carbon capture systems: A state-of-the-art review, Journal of Fuel, <https://doi.org/10.1016/j.fuel.2023.129265>.
22. **Shojaei, M.J.**; Yang, L; Obara, B; Optimizing Image Registration for Integrative Multimodal Data Analysis in Triple-Negative Breast Cancer Tissue, Under review.
23. Wang S, Constantinou1 A, Zhang G, Zhang Y, **Shojaei MJ**, Jones D, Roose T, Blunt MJ, Georgiou T, and Dunlop I, A contrast agent to enable dynamic microscale X-ray computed tomography imaging of the soil aqueous phase: micelle-templated gold nanoparticles, Under review.
24. **Shojaei MJ**, Sivarajah A, Huang C, X-ray Synchrotron Tomography with Deep Learning for Multiscale Analysis of Battery: Unveiling Dynamics of Pore Space and Cathode Thickness during Charge/Discharge Cycle, Under review.

Conference Papers

1. Keshavarzia, **Shojaei, M.J.**, M.H. Ghazanfari, and C. Ghotbi, Wave Attenuation Factor in Ultrasonic Assisted Gravity Drainage Mechanism, The 14th Conference of Chemical Engineering, 3-4 Oct 2012, Iran
2. **Shojaei, M.J.**, M.H. Ghazanfari, and M. Masihi, Concentration Dependent Relative Permeability and Capillary Pressure Curves for Low Salinity Water Flooding in Sandstone Rock, The 8th International Chemical Engineering Congress, and Exhibition (IChEC 2014), 24-27 February 2014, Iran
3. **Shojaei, M.J.**, Osei-Bonsu, K., Shokri, N (2017), Gravitational effects on foam flow in 3D printed heterogeneous porous media in the presence of oil, 9th International Conference on Porous Media & Annual Meeting of the International Society for Porous Media, Rotterdam, The Netherlands
4. **Shojaei, M.J.**, K. Osei-Bonsu, P. Grassia, N. Shokri (2017), Effects of gravity segregation on oil displacement by foam in a 3D printed porous medium, 3rd Annual InterPore UK Chapter Meeting, Warwick, UK
5. **Shojaei, M.J.**, A. Rodriguez de Castro, N. Shokri1 (2018), Fundamental investigation of the effect of local surface roughness on foam flow behavior inside the fracture, EGU General Assembly, Vienna, Austria
6. **Shojaei, M.J.**, Osman, A., Shokri, N, Synergy between Nanoparticles and Surfactants on Foam Stability at Bubble and Bulk-scale, EGU General Assembly, Vienna, Austria, 2019.
7. **Shojaei, M.J.**, Osman, A., Shokri, N, Synergy between Nanoparticles and Surfactants on Foam Stability at Bubble and Bulk-scale, Interpore, Valencia, Spain, 2019.

8. **Shojaei, M.J.**, Dani Or, Shokri, N, Targeted Delivery of Fertilizer in Coarse Textured Soils Using Foam as Carrier, Online Interpore2021 Conference., 2021.
9. **Shojaei, M.J.**, Senyou, A., Niasar, V., Shokri, N, Stability and Performance of Emulsion in Bulk-Scale and Pore-Scale, Online Interpore2021 Conference., 2021.
10. **Shojaei, M.J.**, Bijeljic B; Blunt MJ, Minimal surfaces in gas diffusion layers, Interpore Conference, Abu Dhabi., 2022.
11. **Shojaei, M.J**; Obara, B; . Image Registration for comprehensive multimodal data analysis in triple-negative breast cancer tissue, Wellcome Leap Delta Tissue Conference, Geneva 2023.

Reviewer for Journals: Journal of Colloid and Interface Science, Chemical engineering science, Colloids and Surfaces A: Physicochemical and Engineering Aspects, ACS Omega, Industrial & Engineering Chemistry Research, Advances in Water Resources, Fuel, Energy & Fuel, Transport in Porous Media