MOJTABA BARZEGARI

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Education

- **Ph.D.** in Computational Biomedical Engineering, KU Leuven, Belgium Sep 2018 – Dec 2022
  Thesis: Mathematical and computational modeling of metallic biomaterials biodegradation
- **M.Sc.** in Biomedical Engineering, University of Tehran, Iran Sep 2011 – Sep 2014
  Thesis: Computational analysis of dynamics of urine flow in the lower urinary system in the physiological and pathological conditions using FSI method
- **B.Sc.** in Materials Science and Engineering, Tehran Polytechnic, Iran Sep 2006 – Sep 2011
  Thesis: Prediction of microshrinkage porosities using the permeability parameter modeled with artificial neural networks in Al alloys by finite volume method

Professional Experiences

- Post-doctoral researcher, Electrochemical Materials and Processes Lab, Technical University of Eindhoven (TU/e), Netherlands 2023–Now
  Developing mathematical and high-performance computational models of multi-scale processes in electrochemical systems and large-scale energy storage devices
- Visiting researcher, Multiphysics Simulation and Optimization Lab, University of Southern Denmark, Odense, Denmark 2025
  Developing high-performance computational approaches for topology optimization of multiphysics and multi-scale problems
- Visiting researcher, Computational Science Lab, University of Amsterdam, Netherlands 2022
  Developing and evaluating of high-performance computational models of biomedical systems to scale the computation to thousands of CPU cores
- Ph.D. researcher, Biomechanics Section, KU Leuven, Belgium 2019–2022
  Developing mathematical models and high-performance codes to simulate tissue engineering processes such as biodegradation of biomedical implants and neotissue regeneration
- Software developer, Tehran Polytechnic 2016–2018
  Developing machine learning solutions and implementing open-source embedded applications
- Graduate research assistant, University of Tehran 2012–2014
  Investigating parameters of urology diseases by developing fluid-structure interaction models of urine and human body fluids
- Software developer, Avizheh information technology inc. 2008–2012
  Working on development of big enterprise solutions, applications, and databases
- Freelance engineer and software developer 2006–2016
  Developing various scientific, enterprise, and system level applications using desktop, web, and mobile technologies

Recent Research Projects

- Topology optimization of porous electrodes using scalable modeling approaches (TopeSmash), Marie Currie Individual Fellowship project, TU/e & SDU 2024–2025
- Computational multi-scale modeling of transport phenomena in electrochemical systems with a main focus on redox flow batteries, TU/e 2023–2024
- Development of coupled models of topology optimization and metals corrosion for optimizing the shape of biodegradable medical devices, KU Leuven & Kyoto University 2021–2022

- Development of coupled models of deep reinforcement learning and multiphysics parallel CFD for thermal shape optimization, KU Leuven & University of Waterloo 2021–2022
- Development of open-source software BioDeg for massively-parallel simulation of the chemistry of biodegradation of metallic biomaterials, KU Leuven 2020–2022
- Mathematical modeling and numerical simulation of interface-coupled models of biodegradation behavior of metallic implants and medical devices, KU Leuven 2019–2022
- Mathematical modeling and numerical simulation of biological models of tissue growth and oxygen consumption of cells, KU Leuven & Maastricht University 2019–2022
- Contribution to the development of open-source software ASLI for creating TPMS-based functionally graded scaffolds and implants, KU Leuven 2020–2022
- Development of physics-informed neural network models to solve governing equations of tissue engineering processes (cell growth and oxygen consumption), KU Leuven 2020–2022
- Development of Privacy-Preserving Deep Learning models using Federated Learning and Differential Privacy for healthcare IoT systems, KU Leuven & Duke University 2019–2020
- Implementation of Machine Learning models for signal processing and anomaly detection of EEG and ECG signals, KU Leuven & Imec 2018–2019

Publications

Publications in refereed journals

1. T. Herpelinck, L. Ory, G. Nasello, **M. Barzegari**, J. Bolander, F.P. Luyten, P. Tylzanowski, L. Geris, "A single-cell atlas of the murine limb skeleton integrating the developmental and adult stages", *Scientific Reports*, 2025
2. **M. Barzegari**, A. Forner-Cuenca, "Topology optimization of porous electrodes for electrochemical flow reactors using the finite element method and triply periodic minimal surfaces", *Chemical Engineering Journal*, 2025
3. P. Ansoms, **M. Barzegari**, J. Vander Sloten, L. Geris, "Coupling biomechanical models of implants with biodegradation models: a case study for biodegradable mandibular bone fixation plates", *Journal of the Mechanical Behavior of Biomedical Materials*, 2023
4. B. Liang, E. Sadeghian Dehkord, D. Van Hede, **M. Barzegari**, B. Verlée, J. Pirson, G. Nolens, F. Lambert, L. Geris, "Model-Based Design to Enhance Neotissue Formation in Additively Manufactured Calcium-Phosphate-Based Scaffolds ", *Journal of Functional Biomaterials*, 2023
5. Y. Hao, G. Závodszky, C. Tersteeg, **M. Barzegari**, A.G. Hoekstra, "Image-based flow simulation of platelet aggregates under different shear rates ", *PLOS Computational Biology*, 2023
6. H. Keramati, F. Hamdullahpur, **M. Barzegari**, "Deep reinforcement learning for heat exchanger shape optimization", *International Journal Of Heat And Mass Transfer*, 2022
7. **M. Barzegari**, L. Geris, "BioDeg: A finite element software for the simulation of the corrosion and biodegradation process in metallic biomaterials", *Journal of Open Source Software*, 2022
8. F. Perez Boerema,**M. Barzegari**, L. Geris, "A flexible and easy-to-use open-source tool for designing functionally graded 3D porous structures", *Virtual And Physical Prototyping*, 2022
9. D. Van Hede, B. Liang, S. Anania, **M. Barzegari**, B. Verlee, G. Nolens, J. Pirson, L. Geris, F. Lambert, "3D-Printed Synthetic Hydroxyapatite Scaffold With In Silico Optimized Macrostructure Enhances Bone Formation In Vivo", *Advanced Functional Materials*, 2021
10. **M. Barzegari**, L. Geris, "Highly scalable numerical simulation of coupled reaction-diffusion systems with moving interfaces", *Journal of High Performance Computing Applications*, 2021
11. **M. Barzegari**, D. Mei, S.V. Lamaka, L. Geris, "Computational modeling of degradation process of biodegradable magnesium biomaterials", *Corrosion Science*, 2021
12. J. Barrasa Fano, A. Shapeti, A. Jorge Peñas, **M. Barzegari**, J.A. Sanz-Herrera, H. Van Oosterwyck, "TFMLAB: a MATLAB toolbox for 4D Traction Force Microscopy", *SoftwareX*, 2021
13. **M. Barzegari**, L. Geris, "An open source crash course on parameter estimation of computational models using a Bayesian optimization approach", *Journal of Open Source Education*, 2021
14. F. Firouzi, B. Farahani, **M. Barzegari**, M. Daneshmand, "AI-Driven Data Monetization: The other Face of Data in IoT-based Smart and Connected Health", *IEEE Internet of Things Journal*, 2020

15. **M. Barzegari**, B. Vahidi, M.R. Safarinejad, M. Ebad, "A computational analysis of the effect of supporting organs on predicted vesical pressure in stress urinary incontinence", *Medical & Biological Engineering & Computing*, 2020
16. B. Farahani, **M. Barzegari**, F. Shams Aliee, K. A. Shaik, "Towards collaborative intelligent IoT eHealth: From device to fog, and cloud", *Microprocessors and Microsystems*, 2020
17. **M. Barzegari**, H. Bayani, S. M. H. Mirbagheri, and H. Shetabivash, "Multiphase aluminum A356 foam formation process simulation using lattice Boltzmann method", *Journal of Materials Research and Technology*, 2019
18. H. Bayani, S. M. H. Mirbagheri, **M. Barzegari**, and S. Firoozi, "Simulation of Unconstrained Solidification of A356 Aluminium Alloy on Distribution of Micro/Macro Shrinkage", *Journal of Materials Research and Technology*, 2014

Publications as Book Chapters

1. F. Firouzi, B. Farahani, F. Ye, **M. Barzegari**, "Machine Learning for IoT", *Intelligent Internet of Things*, Springer International Publishing, 2020

Preprints

1. **M. Barzegari**, H. Bayani, S. M. H. Mirbagheri, "A Criterion for Bubble Merging in Liquid Metal: Computational and Experimental Study", arXiv Preprint
2. **M. Barzegari**, B. Vahidi, M. R. Safarinejad, M. Hashemipour "Pathological Analysis of Stress Urinary Incontinence in Females using Artificial Neural Networks", arXiv Preprint

Publications in refereed conference proceedings

1. F. Firouzi, B. Farahani, E. Panahi, **M. Barzegari**, "Task Offloading for Edge-Fog-Cloud Interplay in the Healthcare Internet of Things (IoT)", *Proceedings of the International Conference on Omni-Layer Intelligent Systems*, 2021
2. B. Farahani, **M. Barzegari**, F. Shams Aliee, "Towards Collaborative Machine Learning Driven Healthcare Internet of Things", *Proceedings of the International Conference on Omni-Layer Intelligent Systems*, 2019

Conference and symposium abstracts (as main presenter)

1. (Oral presentation) **M. Barzegari**, T. Jans, P. de Carvalho, R. Jacquemond, A. Forner-Cuenca, "Massively parallel computational modeling of electrode formation via non-solvent induced phase separation for flow batteries", 25th International Conference on Computational Science, 2025
2. (Oral presentation) **M. Barzegari**, P. de Carvalho, B. Liu, A. Forner-Cuenca, "Understanding the impact of the electrode fiber geometry on mass transfer rates with coupled finite element modeling", XI International Conference on Coupled Problems in Science and Engineering, 2025
3. (Oral presentation) **M. Barzegari**, "Topology optimization of porous electrodes in redox flow batteries using scalable modeling approaches", Snellius Advanced Computing Day, 2024
4. (Oral presentation) **M. Barzegari**, M. de Waal, P. de Carvalho, A. Forner-Cuenca, "Inverse design of porous electrodes in redox flow batteries: a computational approach integrating topology optimization and multi-physics modeling", PRiME meeting of Electrochemical Society (ECS), 2024
5. (Oral presentation) **M. Barzegari**, M. de Waal, P. Carvalho, A. Forner-Cuenca, "Topology optimization of porous electrodes for redox flow batteries using the finite element method", 20th Symposium on Modeling and Validation of Electrochemical Energy Technologies (ModVal), 2024
6. (Poster presentation) **M. Barzegari**, M. van der Heijden, V. de Haas, A. Forner-Cuenca, "Multi-{physics, phase, scale} computational modeling of interface-coupled problems in redox flow battery design". 244th meeting of the Electrochemical Society (ECS), 2023
7. (Oral presentation) **M. Barzegari**, L. Geris, "Four years of scientific computing using FreeFEM in the field of computational biomedical engineering". FreeFEM Days, 14th Edition, 2022
8. (Oral presentation) **M. Barzegari**, F. Perez-Boerema, G. Zavodszky, L. Geris, "High-performance computational modeling of metallic biomaterials biodegradation; a case study of a personalized biodegradable porous acetabular ". Virtual Physiological Human Conference (VPH), 2022

9. (Oral presentation) **M. Barzegari**, L. Geris, "Mathematical investigation of corrosion behavior of bioabsorbable metals on the biodegradation interface". 8th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS), 2022
10. (Oral presentation) **M. Barzegari**, L. Geris, "Massively parallel finite element simulation of reaction-diffusion systems with moving boundaries: a use-case for biomaterials degradation modeling". HPC Asia, 2022
11. (Oral presentation) **M. Barzegari**, L. Geris, "BioDeg: corrosion/biodegradation simulation software for metallic biomaterials based on FreeFEM/PETSc/Qt". FreeFEM Days, 13th Edition, 2021
12. (Oral presentation) **M. Barzegari**, L. Geris, "Interactive Educational Materials for Computational Tissue Engineering Using Jupyter Notebooks". 6th World Congress of Tissue Engineering and Regenerative Medicine International Society (TERMIS), 2021
13. (Oral presentation) **M. Barzegari**, L. Geris, "Mathematical modeling of curvature-based cell/tissue growth on open porous scaffolds for bone tissue engineering". 8th Belgian Symposium on Tissue Engineering, 2021
14. (Oral presentation) **M. Barzegari**, L. Geris, "Physics-informed neural network model for cell viability and oxygen consumption of pancreatic islets". Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology conference (MMLDT), 2021
15. (Oral presentation) **M. Barzegari**, L. Geris, "High-performance computing in biomedical engineering; a use-case for biomaterials degradation modeling". 17th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE), 2021
16. (Oral presentation) **M. Barzegari**, D. Mei, S.V. Lamaka, L. Geris, "Mathematical modeling of degradation process of biodegradable metallic biomaterials in immersion and perfusion setups". XXVIII Congress of the International Society of Biomechanics (ISB), 2021
17. (Oral presentation) **M. Barzegari**, L. Geris, "Mathematical modeling of biodegradation of metallic biomaterials using reaction-diffusion equations and level set method". SIAM Conference on Mathematical Aspects of Materials Science, 2021
18. (Oral presentation) **M. Barzegari**, L. Geris, "Reproducible research in computational sciences: A use case for uncertainty quantification using Jupyter notebooks". KU Leuven Open Science Study Day, 2021
19. (Oral presentation) **M. Barzegari**, L. Geris, "Investigating the Biodegradation of Metallic Biomaterials using HPC-Based Simulation Techniques". 14th World Congress on Computational Mechanics, 2021
20. (Oral presentation) **M. Barzegari**, L. Geris, "Computational modeling of in-vitro biodegradation of metallic scaffolds and bone implants". 11th World Biomaterials Congress, 2020
21. (Poster presentation) **M. Barzegari**, L. Geris, "Jupyter for uncertainty quantification and parameter estimation of computational models". JupyterCon, 2020
22. (Oral presentation) **M. Barzegari**, L. Geris, "High-performance numerical simulation of biodegradation process with moving boundaries". FreeFEM Days, 11th Edition, 2019
23. (Oral presentation) **M. Barzegari**, L. Geris, "Computational Modeling Of Biodegradation Of Metallic Biomaterials". 18th National Day on Biomedical Engineering, 2019
24. (Poster presentation) **M. Barzegari**, L. Geris, "Developing a mathematical model of biodegradable metallic scaffolds for bone tissue engineering applications". 7th Belgian Symposium on Tissue Engineering, 2019
25. (Oral presentation) **M. Barzegari**, F.P. Boerema, L. Geris, "Computational optimization and biodegradation of 3D-printed patient-specific acetabular implants". European Orthopaedic Research Society (EORS), 2019
26. (Oral presentation) **M. Barzegari**, L. Geris, "High-performance simulation of biodegradation behavior of magnesium-based biomaterials". Fluid and solid mechanics for tissue engineering, 2019
27. (Oral presentation) **M. Barzegari**, L. Geris, "Numerical simulation of biodegradation and corrosion of magnesiumbased orthopedic implants". 2nd International Conference on Simulation for Additive Manufacturing, 2019
28. (Oral presentation) **M. Barzegari**, L. Geris, "Mathematical modeling of biodegradation of metal implants in orthopedics". 11th Symposium on Biodegradable Metals, Alicante, 2019

Service and Outreach

Associate Editor

- Journal of Open Source Software 2023–2024

Reviewing

- ECS Journal of the Electrochemical Society 2025
- Elsevier Materials & Design 2024–2025
- Springer Multimedia Tools and Applications (for machine learning topics) 2020–2025
- Wiley Advanced Science 2024
- Elsevier Computational and Structural Biotechnology Journal 2024
- Elsevier Results in Engineering 2024
- Elsevier International Journal of Heat and Mass Transfer 2024
- Taylor & Francis Computer Methods in Biomechanics and Biomedical Engineering 2024
- Elsevier Sustainable Computing: Informatics and Systems 2024
- Springer Journal of Porous Materials 2024
- Nature Scientific Reports 2022-2024
- Journal of Open Source Software 2022–2023
- AIMS Mathematical Biosciences and Engineering 2023
- CRC Press, Taylor & Francis Books (book proposal review) 2023
- Elsevier Journal of Computational Science 2021–2022
- SAGE Journal of Mechanical Engineering Science, Part C 2021–2022
- Frontiers in Bioengineering and Biotechnology 2021–2022
- Elsevier Digital Communications and Networks (for machine learning topics) 2022
- IEEE Conference on Omni-Layer Intelligent Systems 2021

Scientific Community

- Organizing and chairing the invited session “Coupled Multi-Scale and Multi-physics Computational Models for Electrochemical Systems” at the COUPLED conference 2025.
- Organizing and chairing the special session “Necessity of high-performance computing to address the scalability issue of biomedical-related computational studies” at the CMBBE conference 2021
- Organizing and chairing the session “Biomaterials for musculoskeletal application” at the TERMIS conference 2021
- Scientific coordinator of the youngster committee of Belgium National Committee on Biomedical Engineering (NCBME) 2020–2022
- Member of the young scientists committee of Virtual Physiological Human Institute 2021–2022

Science Outreach and Open Science

- Running TuxRiders project for sharing open-source scientific computing experiences (TuxRiders.com) (youtube.com/TuxRiders) 2021–2024
- Blogging on technical aspects of scientific computing (mbarzegary.github.io/blog) 2020–2024
- Constantly sharing developed models and codes on GitHub (github.com/mbarzegary) 2018–2024
- Active member of the FreeFEM community (community.freefem.org) 2019–2023

Teaching Experiences

Teaching Assistance

- Mass transfer in tissue engineering (MSc), KU Leuven 2020–2021
  Lecture on computational mass transfer, accompanied by Jupyter notebooks
- Transport phenomena in biomedical engineering (BSc), KU Leuven 2020
  Designing biomedical-related examples and exercises for the mass transfer part
- Musculoskeletal biomechanics (BSc), KU Leuven 2020
  Developing Jupyter notebooks for self-teaching biomedical image segmentation

Workshops and Invited Talks

- "A firsthand account of the journey, challenges, and successes in securing the MSCA fellowship", TU/e Research Support Office Training Webinar on Marie-Curie Proposal Writing 2025
- "Topology optimization of porous electrodes in flow batteries using multi-scale electrochemical modeling", Danish Center for Applied Mathematics and Mechanics (DCAMM) 2025
- "Finite element modeling in FreeFEM for computational biomedical engineering", European Society of Biomechanics (ESB), Webinar 2023
- "Computational Modeling of Biodegradation Behavior of Personalized Printed Implants", Simulation-based Science (SbS) community, University of Amsterdam 2022
- "Open Source in Multi-Scale Modeling", 1st SGABU Project Workshop, Virtual 2021
- "Towards Embedded Systems, Motivational Role of Free Software", Tehran Software Freedom Day Festival, Sharif University of Technology 2016
- "An introduction to LaTeX for thesis typesetting", University of Tehran 2013

Community Teaching

- Advanced programming for electrical engineering students 2016
- Metal casting simulation for mechanical engineering students 2014
- Scientific computing concepts for biomedical engineering students 2011
- Computer basics and mathematics for kids 2013-2016

Supervision and Mentorship

PhD thesis

- Ms. Sophie Nguyen: "In silico design of degradable joint implants for optimal balancing of tissue formation and implant degradation", KU Leuven 2024–2027
- Mr. Davide Bordignon: "Computational and experimental evaluation of micro-patterned porous electrodes for redox flow batteries", TU/e (research visit) 2024–2025

MSc thesis

- Ms. Adele Rosinaite: "Topology optimization of porous electrodes in redox flow batteries using triply periodic minimal surfaces (TPMS)", TU/e 2024–2025
- Ms. Tess Jans: "Phase field modeling of Non-Solvent Induced Phase Separation (NIPS) for designing porosity gradient and alternative electrode microstructures", TU/e 2024
- Mr. Martin de Waal: "Modeling of redox flow battery electrodes and flow fields using OpenFOAM", TU/e 2023–2024
- Mr. Pedro de Carvalho Ferreira: "Finite element modeling of transport phenomena in porous electrodes of redox flow batteries", TU/e 2023–2024
- Mr. Merlijn Randolph Schinkel: "Investigation of flooding-causing mechanisms in a CO_2 reduction system", TU/e 2023–2024
- Ms. Anne Slegers: "Computational design and performance evaluation of a triple phase electrochemical boundary for hydrogen evolution reaction in alkaline media", TU/e 2023–2024

- Mr. Rob Hoffmann: "Modeling relevant phenomena on the atomistic scale influencing meso-scale properties in flow batteries", TU/e 2023–2024
- Ms. Jessica Vacca (MSc internship project): "A machine learning-based framework for the inverse mechanical characterization of soft tissues, P1", KU Leuven 2022–2023
- Ms. Giulia Rizzuti (MSc internship project): "A machine learning-based framework for the inverse mechanical characterization of soft tissues, P2", KU Leuven 2022–2023
- Mr. Kwinten Van Meerbeek: "Towards using physics-informed neural network models for computer simulations in tissue engineering", KU Leuven 2021–2022
- Mr. Tijs Vanbosseghem: "Studying the controlled release and degradation of the metallic biomaterials using finite element simulations", KU Leuven 2021–2022
- Mr. Pieter Ansoms: "Finite element analysis of mechanical behavior during the implant biodegradation process", KU Leuven 2020–2021

BSc project

- Daily supervision of 15 students (mechanical engineering) for the "Problem Solving and Design" course on "Improving a pre-cleaner design" project, KU Leuven 2019–2020

Awards and Grants

- Marie Sklodowska-Curie Actions (MSCA) European Individual Postdoctoral Fellowship 2024
- André Schroeder Research Prize for the preclinical paper “3D-Printed Synthetic Hydroxyapatite Scaffold With In Silico Optimized Macrostructure Enhances Bone Formation In Vivo” 2023
- VPHi Best Student Award, VPH 2022 conference 2022
- Research Foundation Flanders (FWO) travel grant for doing a research visit to the Computational Science Lab at the University of Amsterdam 2022
- Best short oral and poster presentation prize in the corrosion topic, Biometal Symposium 2019
- Best hands-on project prize on "Machine learning and mechanistic tissue modeling for image-guided brain surgery", VPH Summer School 2019
- Best thesis award of the Department of Materials Science, Tehran Polytechnic 2011
- 2nd Place in Khwarizmi young award of scientific innovation in the field of mathematics (project title: mathematical computation and function plotting software) 2004

Technical Skills

- **Programming Languages & Frameworks** C, C++, C#, Python, Java, Visual Basic, Qt, .NET and .NET Core, Xamarin, Universal Windows Platform (UWP)
- **Scientific Computing** MATLAB & GNU Octave, Maple, FreeFEM, FEniCS, OpenFOAM, Firedrake
- **Parallel Computing** MPI, PETSc, OpenMP, OpenACC, CUDA
- **Machine Learning** Scikit-learn, Keras, TensorFlow, TF Federated, NVIDIA Modulus, HyperOpt
- **Engineering Software** SolidWorks, ANSYS, COMSOL, FreeCAD, SALOME, GMSH, ParaView