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, 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 2016–2017
  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. 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
2. 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
3. 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
4. H. Keramati, F. Hamdullahpur, **M. Barzegari**, "Deep reinforcement learning for heat exchanger shape optimization", *International Journal Of Heat And Mass Transfer*, 2022
5. **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
6. 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
7. 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
8. **M. Barzegari**, L. Geris, "Highly scalable numerical simulation of coupled reaction-diffusion systems with moving interfaces", *Journal of High Performance Computing Applications*, 2021
9. **M. Barzegari**, D. Mei, S.V. Lamaka, L. Geris, "Computational modeling of degradation process of biodegradable magnesium biomaterials", *Corrosion Science*, 2021
10. 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
11. **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
12. 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
13. **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
14. 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
15. **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
16. 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. T. Herpelinck, L. Ory, G. Nasello, **M. Barzegari**, J. Bolander, F.P. Luyten, P. Tylzanowski, L. Geris, "An integrated single-cell atlas of the skeleton from development through adulthood", bioRxiv Preprint
2. **M. Barzegari**, H. Bayani, S. M. H. Mirbagheri, "A Criterion for Bubble Merging in Liquid Metal: Computational and Experimental Study", arXiv Preprint
3. **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**, 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
2. (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
3. (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
4. (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
5. (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
6. (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
7. (Oral presentation) **M. Barzegari**, L. Geris, "BioDeg: corrosion/biodegradation simulation software for metallic biomaterials based on FreeFEM/PETSc/Qt". FreeFEM Days, 13th Edition, 2021
8. (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
9. (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
10. (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
11. (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

12. (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
13. (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
14. (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
15. (Oral presentation) **M. Barzegari**, L. Geris, "Investigating the Biodegradation of Metallic Biomaterials using HPC-Based Simulation Techniques". 14th World Congress on Computational Mechanics, 2021
16. (Oral presentation) **M. Barzegari**, L. Geris, "Computational modeling of in-vitro biodegradation of metallic scaffolds and bone implants". 11th World Biomaterials Congress, 2020
17. (Poster presentation) **M. Barzegari**, L. Geris, "Jupyter for uncertainty quantification and parameter estimation of computational models". JupyterCon, 2020
18. (Oral presentation) **M. Barzegari**, L. Geris, "High-performance numerical simulation of biodegradation process with moving boundaries". FreeFEM Days, 11th Edition, 2019
19. (Oral presentation) **M. Barzegari**, L. Geris, "Computational Modeling Of Biodegradation Of Metallic Biomaterials". 18th National Day on Biomedical Engineering, 2019
20. (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
21. (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
22. (Oral presentation) **M. Barzegari**, L. Geris, "High-performance simulation of biodegradation behavior of magnesium-based biomaterials". Fluid and solid mechanics for tissue engineering, 2019
23. (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
24. (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

- Wiley Advanced Science 2024
- Elsevier Computational and Structural Biotechnology Journal 2024
- Elsevier International Journal of Heat and Mass Transfer 2024
- Springer Journal of Porous Materials 2024
- Nature Scientific Reports 2022-2024
- Springer Multimedia Tools and Applications (for machine learning topics) 2020–2024
- 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 special session “Necessity of high-performance computing to address the scalability issue of biomedical-related computational studies” in CMBBE conference 2021
- Organizing and chairing the session “Biomaterials for musculoskeletal application” in 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

- “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", KU Leuven 2024–2027

MSc thesis

- Ms. Adele Rosinaite: "Computational design 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