

# MOJTABA BARZEGARI

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## Education

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- **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

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- 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

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- Computational multi-scale modeling of transport phenomena in electrochemical systems with a main focus on redox flow batteries, TU/e 2023-2025
- 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

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### Publications in refereed journals

1. H. Keramati, F. Hamdullahpur, **M. Barzegari**, "[Deep reinforcement learning for heat exchanger shape optimization](#)", *International Journal Of Heat And Mass Transfer*, 2022
2. **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
3. 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
4. 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
5. **M. Barzegari**, L. Geris, "[Highly scalable numerical simulation of coupled reaction-diffusion systems with moving interfaces](#)", *Journal of High Performance Computing Applications*, 2021
6. **M. Barzegari**, D. Mei, S.V. Lamaka, L. Geris, "[Computational modeling of degradation process of biodegradable magnesium biomaterials](#)", *Corrosion Science*, 2021
7. 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
8. **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
9. 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
10. **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
11. 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
12. **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
13. 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. Y. Hao, G. Závodszy, C. Tersteeg, **M. Barzegari**, A.G. Hoekstra, "[Image-based Flow Simulation of Platelet Aggregates under Different Shear Rates](#)", biorXiv Preprint
2. 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
3. **M. Barzegari**, H. Bayani, S. M. H. Mirbagheri, "[A Criterion for Bubble Merging in Liquid Metal: Computational and Experimental Study](#)", arXiv Preprint
4. **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**, L. Geris, "Four years of scientific computing using FreeFEM in the field of computational biomedical engineering". FreeFEM Days, 14th Edition, 2022
2. (Oral presentation) **M. Barzegari**, F. Perez-Boerema, G. Závodszy, 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
3. (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
4. (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
5. (Oral presentation) **M. Barzegari**, L. Geris, "BioDeg: corrosion/biodegradation simulation software for metallic biomaterials based on FreeFEM/PETSc/Qt". FreeFEM Days, 13th Edition, 2021
6. (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
7. (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
8. (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
9. (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
10. (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
11. (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

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

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### Reviewing

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| • Journal of Open Source Software  | 2022-2023 |
| • Springer Multimedia Tools and Applications (for machine learning topics)   | 2020-2023 |
| • AIMS Mathematical Biosciences and Engineering                              | 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 |
| • Nature Scientific Reports  | 2022      |
| • Elsevier Digital Communications and Networks (for machine learning topics) | 2022      |
| • IEEE Conference on Omni-Layer Intelligent Systems                          | 2021      |

### Scientific Community

- Organizing special session "Necessity and importance of high-performance computing to address the scalability issue of biomedical-related computational studies" in CMBBE conference 2021
- Organizing 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](https://TuxRiders.com)) ([youtube.com/TuxRiders](https://youtube.com/TuxRiders)) 2021-2023
- Blogging on technical aspects of scientific computing ([mbarzegary.github.io/blog](https://mbarzegary.github.io/blog)) 2020-2023
- Constantly sharing developed models and codes on GitHub ([github.com/mbarzegary](https://github.com/mbarzegary)) 2018-2023
- Active member of the FreeFEM community ([community.freefem.org](https://community.freefem.org)) 2019-2023

## Teaching Experiences

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### 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

### Supervision and Mentoring

- 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, MSc thesis project: "Towards using physics-informed neural network models for computer simulations", KU Leuven 2021-2022
- Mr. Tijs Vanbosseghem, MSc thesis project: "Studying the controlled release and degradation of the metallic biomaterials using finite element simulations", KU Leuven 2021-2022
- Mr. Pieter Ansoms, MSc thesis project: "Finite element analysis of mechanical behavior during the implant biodegradation process", KU Leuven 2020-2021
- 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

### Workshops and Invited Talks

- "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  $\text{\LaTeX}$  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

## Awards and Grants

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- 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

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- **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
- **Parallel Computing** MPI, PETSc, OpenMP, OpenACC, CUDA
- **Machine Learning** Scikit-learn, Keras, TensorFlow, TF Federated, SimNet, HyperOpt
- **Engineering Software** SolidWorks, ANSYS, COMSOL, FreeCAD, SALOME, GMSH, ParaView