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Education

Ph.D. Researcher — 2018 – Now
Biomechanics Section, KU Leuven — Leuven, Belgium

- **Field:** Computational Tissue Engineering
- **Project Title:** Computational Multiscale Modeling of Biodegradation Behavior of Personalized Printed Implants
- **Supervisor:** Prof. Liesbet Geris

Master of Science in Biomedical Engineering — 2011 – 2014
Department of Life Science Engineering, University of Tehran — Tehran, Iran

- **Major:** Biomaterials
- **Thesis:** Computational and Experimental Analysis of Dynamics of Urine Flow in the Lower Urinary System in the Physiological and Pathological Conditions using FSI Method
- **Supervisor:** Prof. Bahman Vahidi

Bachelor of Science in Materials Science and Engineering — 2006 – 2011
Department of Materials Engineering, Amirkabir University — Tehran, Iran

- **Major:** Industrial Metallurgy
- **Thesis:** Prediction of Microshrinkage Porosities using the Permeability Parameter Modeled with Artificial Neural Networks in Al-6%Si Alloy by Finite Volume Method
- **Supervisor:** Prof. S.M.H. Mirbagheri

Research Interests

- Scientific Computing
- Computational Engineering
- GPU programming and High-Performance Computing
- Machine Learning and Computational Intelligence
- Computational Biomechanics
- Computational Materials Science

Research Projects

Computational Tissue Engineering

- Development of open-source software BioDeg for massively-parallel simulation of biodegradation and corrosion of metallic biomaterials, KU Leuven 2020–2021
- Mathematical modeling and numerical simulation of biodegradation behavior of metallic implants and medical devices, KU Leuven 2018–2021
- Mathematical modeling and numerical simulation of bone tissue growth process, KU Leuven 2019–2021
- Contribution to the development of open-source software ASLI for creating TPMS-based functionally graded scaffolds and implants, KU Leuven 2020-2021
- Numerical modeling of oxygen consumption and cell viability for pancreatic islets, KU Leuven & Maastricht University 2019–2021
- Development of coupled models of topology optimization and metals corrosion for optimizing the shape of biodegradable medical devices, KU Leuven & Kyoto University 2021

Computational Fluid Dynamics

- Numerical modeling of foam formation process using Lattice Boltzmann method and multiphase fluid simulation, Amirkabir University of Technology 2013–2017
- Development of coupling simulation software packages to link multiphysics CFD models and AI, Amirkabir University of Technology 2010–2011
- Development of in-house CFD codes for simulating fluid flow and heat transfer in metal casting process, Amirkabir University of Technology 2008–2011

Computational Biomechanics

- Contribution to the development of open-source software TFMLab for traction force microscopy calculations of cellular movements, KU Leuven 2020
- Implementation of Fluid-Structure Interactions models to simulate fluid dynamics of human body fluids, University of Tehran 2012–2014

Computational Materials Science

- Development of dendrite and microstructure growth models to simulate the solidification process of metals, Amirkabir University of Technology 2009–2011
- Development of heat transfer simulation codes in order to model heat treatment in metals, Amirkabir University of Technology 2008

Machine Learning and Computational Intelligence

- Development of physics-informed neural network models to solve governing equations of tissue engineering processes (cell growth and oxygen consumption), KU Leuven 2020-2021
- 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
- Implementation of ANN models to investigate complex parameters of urology diseases, University of Tehran 2013–2014
- Implementation of ANN models to investigate relations between porous media parameters and permeability, Amirkabir University of Technology 2010–2011

Publications

Publications in refereed journals

1. **M. Barzegari**, L. Geris, "Highly scalable numerical simulation of coupled reaction-diffusion systems with moving interfaces", *International Journal of High Performance Computing Applications*, vol. 35, 2021
2. **M. Barzegari**, D. Mei, S.V. Lamaka, L. Geris, "Computational modeling of degradation process of biodegradable magnesium biomaterials", *Corrosion Science*, vol. 190, pp. 109674, 2021
3. 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*, vol. 15, pp. 100723, 2021
4. **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*, vol. 4, no. 40, 2021
5. 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
6. **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*, vol. 58. no. 5, pp. 1079-1089, 2020
7. B. Farahani, **M. Barzegari**, F. Shams Aliee, K. A. Shaik, "Towards collaborative intelligent IoT eHealth: From device to fog, and cloud", *Microprocessors and Microsystems*, vol. 72, p. 102938, 2020
8. **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*, vol. 8, no. 1, pp. 1258–1266, 2019
9. 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*, vol. 3, no. 1, pp. 55-70, 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, pp. 243–313, 2020
2. S. M. H. Mirbagheri, H. Bayani, **M. Barzegari**, S. Firoozi, "Simulation of Liquid Flow Permeability for Dendritic Structures during Solidification Process", *Computational Fluid Dynamics Technologies and Applications*, Intec, 2011

Preprints and Submitted Papers

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*, Crete, Greece, 2019

Conference and symposium abstracts (as main presenter)

1. (Oral presentation) **M. Barzegari**, L. Geris, (2021), "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), Virtual, Sep 2021

2. (Oral presentation) **M. Barzegari**, L. Geris, (2021), "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), Virtual, Sep 2021

3. (Oral presentation) **M. Barzegari**, D. Mei, S.V. Lamaka, L. Geris, (2021), "Mathematical modeling of degradation process of biodegradable metallic biomaterials in immersion and perfusion setups". XXVIII Congress of the International Society of Biomechanics (ISB), Virtual, July 2021

4. (Oral presentation) **M. Barzegari**, L. Geris, (2021), "Mathematical modeling of biodegradation of metallic biomaterials using reaction-diffusion equations and level set method". SIAM Conference on Mathematical Aspects of Materials Science, Virtual, May 2021

5. (Oral presentation) **M. Barzegari**, L. Geris, (2021), "Reproducible research in computational sciences: A use case for uncertainty quantification using Jupyter notebooks". KU Leuven Open Science Study Day, Virtual, Apr 2021

6. (Oral presentation) **M. Barzegari**, L. Geris, (2021), "Investigating the Biodegradation of Metallic Biomaterials using HPC-Based Simulation Techniques". 14th World Congress on Computational Mechanics, Virtual, Jan 2021

7. (Oral presentation) **M. Barzegari**, L. Geris, (2020). "Computational modeling of in-vitro biodegradation of metallic scaffolds and bone implants". 11th World Biomaterials Congress, Virtual, Dec 2020

8. (Poster presentation) **M. Barzegari**, L. Geris, (2020). "Jupyter for uncertainty quantification and parameter estimation of computational models". JupyterCon, Virtual, Oct 2020

9. (Oral presentation) **M. Barzegari**, L. Geris, (2019). "High-performance numerical simulation of biodegradation process with moving boundaries". FreeFEM Days, 11th Edition, Paris, France, Dec 2019

10. (Oral presentation) **M. Barzegari**, L. Geris, (2019). "Computational Modeling Of Biodegradation Of Metallic Biomaterials". 18th National Day on Biomedical Engineering, Brussels, Belgium, Nov 2019

11. (Poster presentation) **M. Barzegari**, L. Geris, (2019). "Developing a mathematical model of biodegradable metallic scaffolds for bone tissue engineering applications". 7th Belgian Symposium on Tissue Engineering, Hasselt, Belgium, Nov 2019

12. (Oral presentation) **M. Barzegari**, F.P. Boerema, L. Geris, (2019). "Computational optimization and biodegradation of 3D-printed patient-specific acetabular implants". European Orthopaedic Research Society (EORS) 2019, Maastricht, the Netherlands, Oct 2019

13. (Oral presentation) **M. Barzegari**, L. Geris, (2019). "High-performance simulation of biodegradation behavior of magnesium-based biomaterials". Fluid and solid mechanics for tissue engineering, Oxford, UK, Sep 2019

14. (Oral presentation) **M. Barzegari**, L. Geris, (2019). "Numerical simulation of biodegradation and corrosion of magnesiumbased orthopedic implants". 2nd International Conference on Simulation for Additive Manufacturing, Pavia, Italy, Sep 2019

15. (Oral presentation) **M. Barzegari**, L. Geris, (2019). "Mathematical modeling of biodegradation of metal implants in orthopedics". 11th Symposium on Biodegradable Metals, Alicante, Spain, Aug 2019

Conference and symposium abstracts (as co-author)

1. R. de Vries, **M. Barzegari**, S. Mohammed, A. Stell, C. Hermanns, M. Jetten, D. de Bont, O.P. da Silva Filho, V. Vaithilingam, A Carlier, L. Geris, A. van Apeldoorn, (2021), "Upscaling of a Next Generation Microwell-Based Beta Cell Replacement Device". 6th TERMIS World Congress on Tissue Engineering and Regenerative Medicine (TERMIS), Nov 2021
2. F. Perez-Boerema, **M. Barzegari**, L. Geris, (2021), "Creating your own TPMS-based functionally graded scaffolds for 3D-printing". 17th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE), Sep 2021
3. J.B. Fano, A. Shapeti, M. Cóndor, J. De Jong, A.A. Fernández, **M. Barzegari**, J.A. Sanz-Herrera, H. van Oosterwyck, (2021), "Quantifying cellular forces in a 3D in vitro vascular model". 17th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE), Sep 2021

Publications in non-English (Persian) journals and proceedings

1. **M. Barzegari**, B. Vahidi, M. R. Safarinejad, "Investigating Stress Urinary Incontinence in Women Using Computational Methods and Clinical Data", *Journal of Modares Mechanical Engineering*, vol. 17, no. 5, pp. 417-427, 2017
2. **M. Barzegari**, B. Vahidi, M. R. Safarinejad, "Computational Simulation of Stress Urinary Incontinence using Fluid-Structure Interaction Analysis", *25th International Conference on Mechanical Engineering*, Tehran, Iran, 2017
3. **M. Barzegari**, H. Bayani, S. M. H. Mirbagheri, "Computational and Experimental Investigation of Air Bubbles Coalescence in Metal Melts", *25th International Conference on Mechanical Engineering*, Tehran, Iran, 2017
4. S. Gholami, A. Danayi, A. Rezaee, **M. Barzegari**, "Embedded Systems and the Challenge of Complex Computing in Internet of Things", *1st International Conference on Internet of Things, Applications and Infrastructure*, Isfahan, Iran, 2017
5. S. M. H. Mirbagheri, H. Bayani, **M. Barzegari**, "Micro Shrinkages Simulation in Mushy Zone by Permeability Calculation", *Journal of Iranian Foundrymen's Society*, vol. 102, pp. 42-50, 2013
6. **M. Barzegari**, S. M. H. Mirbagheri, "Assessment of the Slope and Cross-Section of In-Gate on the Pressure and Flow Pattern Using Finite Volume Method", *Journal of Metallurgical and Materials Engineering*, vol. 22, no. 2, pp. 21-36, 2011

Teaching Experiences

Teaching Assistance

- Mass transfer in tissue engineering (MSc), KU Leuven 2020-2021
- Transport phenomena in biomedical engineering (BSc), KU Leuven 2020
- Musculoskeletal biomechanics (BSc), KU Leuven 2020

Supervision and Mentoring

- Mr. Kwinten Van Meerbeek, MSc thesis project: "Can machine learning replace the computer models of tissue engineering? Towards using physics-informed neural network models for computer simulations", KU Leuven 2021–2022
- Mr. Tijs Vanbosseghem, MSc thesis project: "What happens to biodegradable implants inside the body? 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 supervisory of 15 students (mechanical engineering) for the "Problem Solving and Design" course on "Improving a pre-cleaner design" project, KU Leuven 2019–2020

Workshops

- "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

Unofficial/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

- 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
- Awarded researcher of the Department of Materials Science and Engineering, Amirkabir University of Technology 2011
- 2nd Place in Khwarizmi young award of scientific innovation in the field of mathematics (project title: mathematical computation and function plotting software) 2004

Professional Projects and Work Experiences

Selected projects (among 20 more) in 15 years of professional software development and computer programming experiences (2003–2017):

Internet of Things & Embedded Systems

- Design and implementation of smart home solutions based on IoT and Cloud Computing paradigms, Freelance projects 2016–2017
- Design and implementation of embedded systems and embedded Linux programs using C, C++, Python and GNU toolchains, Amirkabir University of Technology 2016–2017

Web & Mobile Applications

- Implementation of resources and documents management software for Iran Red Crescent Society using C# and .NET web technologies 2015–2016
- Implementation of online shopping system for Parhoon Koosha Co. using PHP 2016
- Implementation of Android-based enterprise apps using Java and Xamarin technologies, Freelance projects 2015–2016
- Development and optimization of the UI of comprehensive medical instruments software developed in C#, Avizheh IT Co. 2014
- Development of commission management software for Tehran Municipality using C# and .NET web technologies 2011

Desktop & Enterprise Applications

- Development of estate profiling software using C#, Venus IT Co. 2013
- Development of Tehran districts profiling and reporting software for Tehran Municipality using C# and .NET technologies 2012
- Development of office and workflow automation software for Iran Tube and Machine Manufacturing Corporation using C# and .NET technologies, Avizheh IT Co. 2010–2011
- Development of project control and operational automation software for Iran Railway Corporation using VB and .NET technologies, Avizheh IT Co. 2008–2011.
- Development of workflow management software for Parhoon Koosha Co. using C# and .NET technologies 2006

Scientific Applications

- Implementation of SUTCast simulation software code in MATLAB (fluid flow and heat transfer modules), Razi Research Center of Applied Science 2015
- Implementation of ANN models for optimization of rolling parameters in Mobarakeh Steel Manufacturing Co. using MATLAB 2014
- Development of mathematical computation and function plotting software using C# (Awarded as the 2nd place in Khwarizmi young award of scientific innovation) 2004
- Development of robot control software using VB, Iran Students' Foundation 2003

Technical Skills

- **Operating Systems**
  Microsoft Windows (Client & Server), GNU/Linux (Desktop & Embedded)
- **Programming Languages & Frameworks**
  C, C++, C#, Python, Java, Visual Basic, T-SQL, ActionScript, Qt, .NET and .NET Core, Android app development, Xamarin, Universal Windows Platform (UWP), Arduino
- **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
- **Databases**
  Microsoft SQL Server, MySQL (MariaDB), SQLite
- **Web Development**
  HTML, CSS, JavaScript, PHP, ASP.NET, Django, React, Dash
- **Engineering Software Packages**
  SolidWorks, ANSYS (Mechanical, Fluent, Explicit Dynamics & AUTODYN), ProCAST, MSC Patran, MD ADAMS, COMSOL, FreeCAD, SALOME, GMSH, ParaView
- **Other**
  LaTeX, Docker, Git

Personal Details

- **Date of Birth:** February 25th, 1988
- **Nationality:** Iranian
- **Languages Known:**
  - Persian: Native
  - English: Fluent
- **Extracurricular Activities:**
  - Amateur guitar playing (bass player of folk band "Me, Moon, and You")
  - Playing volleyball & chess
  - Swimming & biking
  - Playing computer & mobile games
  - Reading science, music, and history books