

Rozhin Derakhshandeh, PH. D.

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EDUCATION

Purdue University

West Lafayette, IN

M.S. & PhD. in Mechanical Engineering

Aug 2019- Spring 2025 (Expected Graduation Date)

- Dissertation title: Subcutaneous Injection Physics of Therapeutic Proteins.
- Advisor: Prof. Pavlos P. Vlachos.
- Experimentalist with interdisciplinary experience in mechanical engineering, biomedical engineering, and measurement & data science.
- Highly skilled in combination product development, imaging, and advanced image processing.
- A result-oriented scientist with 6 first-author journal papers, 4 conference presentations, and 2 IPs.

TECHNICAL SKILLS

- **Medical Devices:** R&D in Medical Devices, New Product Development (NPD), Combination Products, Autoinjectors, ISO 11608 (requirements and test methods for needle-based injection systems).
- **Experimentation:** Design of Experiments, Measurement & Data Science, Signal/Image Processing, Hands-on experience with Zwick machine, SEC, MFI, HIAC, high-speed cameras (Phantom), high-power lasers, synchronizers, load cells, pressure transducers, flowmeters, gear pumps, DAQ boards, and optical arrangements.
- **Imaging:** Optical Imaging (2D and 3D), Ultrasound Imaging, Photoacoustic Imaging, Radiography, Computational Tomography (CT), and Light Sheet Microscopy (LSM).
- **Programming:** MATLAB, Python.
- **Computer-aided Design:** SolidWorks, AutoCAD.
- **Analysis & Simulation:** ANSYS Fluent (CFD), COMSOL Multiphysics (FEA).
- **Software:** JMP, LabVIEW, ImageJ, Microsoft Office, LaTeX.
- **Experiments in Fluid Mechanics:** Particle Image Velocimetry (PIV), Ultrasound Image Velocimetry (UIV).
- **Data Assimilation and Machine Learning:** Uncertainty Quantification, Automated Machine Learning (Toolkit: Autosklearn), Deep Learning (Toolkits: TensorFlow, PyTorch).

EXPERIENCE

Purdue University, Vlachos Research Group

West Lafayette, IN

Research Assistant

Aug 2019- Dec 2024

- Conducted advanced imaging, image processing, and measurement science techniques to analyze biomedical and biological flows, focusing on cardiovascular dynamics and the delivery mechanisms of injected medications.
- Collaborated in the Purdue-Eli Lilly strategic partnership, involving over 30 faculties and 100 students, concentrating on optimizing injectable medicine delivery systems, to enhance drug bioavailability, and improve patient compliance.
- Developed experimental frameworks using high-speed imaging and advanced image processing to enhance understanding of autoinjector performance, considering factors such as patient usability, premature drug dispensing, dose accuracy, needle dynamics, activation force, injection flow rate, and injection duration.
- Implemented a robust image processing framework to study drug morphology and diffusion in ex-vivo tissue, focusing on studying the drug bioavailability, and the impact of device design on patient experience. This framework applies to radiography, Computational tomography (CT), and Light Sheet Microscopy (LSM) images.
- Established impact of flow rate and injection site on uptake of large molecule therapeutics via subcutaneous injection using Bovine Serum Albumin (BSA) conjugated with Rose Bengal as contrast agents, administered into porcine tissue, and imaged by micro-CT scan, with comprehensive analysis through an intensity-based image processing framework.

- Conducted focused research on autoinjector devices, evaluating performance in alternative dosing through extensive testing methods such as high-speed imaging, Zwick testing, Size Exclusion Chromatography (SEC), Micro-Flow Imaging (MFI), and High-Speed Image Analysis Counter (HIAC).
- Utilized high-speed synchrotron radiography at the Canadian Light Source to investigate timing and depth of drug product delivery in subcutaneous injection.
- Gained experience with design controls, risk management, and performance requirements for combination products. Established knowledge in primary and secondary packaging, as well as Container-Closure Integrity (CCI) testing.
- Explored the societal impact of the pharmaceutical industry and gained insights into phases of drug development, from discovery to commercialization.

ACTIVITIES AND LEADERSHIP

- President of the Iranian Cultural Club (ICC) at Purdue University (2021-2023).
- President of the Scientific Association of Mechanical Engineering (SAME) at the University of Tehran (2016-2018).
- Mentored junior scientists and technologists in the Vertically Integrated Projects (VIP) Program at Purdue University, leading the Pharma LPRC team in advancing pharmaceutical innovation to improve medicine and patient care (Spring 2024).
- Teaching Assistant in Fluid Mechanics (Fall 2021) and Fluid Lab (Spring/Fall 2024) at Purdue University.
- Teaching Assistant in Heat Transfer (Spring 2018) and Thermodynamics (Spring 2018) at the University of Tehran.
- Student Volunteer at PDA Universe of Pre-Filled Syringes and Injection Devices Conference 2024, Phoenix, AZ.
- F45 trainer at Purdue University (Fall 2024).

PUBLICATIONS

- R. Derakhshandeh, J. Eshraghi, M. Tavakolian, K. H. Duffy, J.-C. Veilleux, G. H. Shi, P. P. Vlachos, "Performance characterization of spring-actuated autoinjector devices for Lebrikizumab and Dupixent," submitted to *Expert Opinion on Drug Delivery*.
- R. Derakhshandeh, J. Zhang, B.A. Meyers, J.-C. Veilleux, G. H. Shi, P.P. Vlachos, "Evaluating the impact of autoinjector design on the injected depot morphology and tissue diffusion using high-speed synchrotron radiography," submitted to *International Journal of Pharmaceutics*.
- R. Derakhshandeh, M. Hakim, L. Solorio, P.P. Vlachos, "Three-dimensional subcutaneous injection plume formation in ex vivo porcine model: injection rate and location importance," in progress.
- R. Derakhshandeh, J. Eshraghi, J.-C. Veilleux, P.P. Vlachos, "Assessment of alternative dosing volume in autoinjectors: an approach to add flexibility to autoinjector platforms," submitted to *Expert Opinion on Drug Delivery*.
- R. Derakhshandeh, S. Bhattacharya, B.A. Meyers, P.P. Vlachos, "Ultrasound PIV uncertainty quantification," submitted to *Journal of Ultrasound in Medicine*.
- R. Derakhshandeh, S. Bhattacharya, P.P. Vlachos, "3D PIV uncertainty quantification," in progress.
- R. Derakhshandeh, S. Bhattacharya, B.A. Meyers, P.P. Vlachos, "Ultrasound PIV uncertainty quantification," APS 2022.
- R. Derakhshandeh, S. Bhattacharya, P.P. Vlachos, "3D PIV uncertainty quantification," ISPIV 2023.

INTELLECTUAL PROPERTIES

- "Testing the performance of push-button-activated and press-shell-activated autoinjectors (AIs)", IP by Purdue University, No. 2023-VLAC-70119.
- "Assessment of the drug delivery phenomena in the tissue injection using high-speed synchrotron radiography", IP by Purdue University, No. 2023-VLAC-70118.