JEAN CARLOS SERRANO

US Citizen ⋄ jeancs@alum.mit.edu
Cambridge, MA USA ⋄ jeancserrano.github.io

IN BRIEF

Leveraging a strong foundation in biological transport phenomena and numerical simulations to engineer advanced biological systems, including microphysiological platforms and organoids, for disease modeling and preclinical drug testing. Integrating computational modeling, quantitative imaging, and molecular biology to mechanistically model pathophysiology and pharmacological responses across multiple scales.

EDUCATION

Massachusetts Institute of Technology *September 2018 - June 2021*
Ph.D. in Mechanical Engineering
Thesis: On-Chip Engineered Human Lymphatic Microvasculature for Physio-/Pathological Transport Phenomena Studies

Massachusetts Institute of Technology *September 2016 - June 2018*
M.S. in Mechanical Engineering
Thesis: Engineering 3D Lymphatic Vasculature On-Chip Through Biochemical and Mechanical Stimuli

University of Puerto Rico at Mayaguez *August 2012 - June 2016*
B.S. in Mechanical Engineering (Summa Cum Laude)
Honors Thesis: Adaptive Responses of Murine Osteoblasts Subjected to Coupled Mechanical Stimuli

WORK EXPERIENCE

Harvard University July 2024 - Present
Associate Fellow

· Continued scientific advising of organoid technologies and mRNA therapeutics through a Wyss Institute Partnership.

Cellino Biotech May 2023 - June 2024
Biomedical Fluidic Engineer

Biophysical Characterization and Modeling of iPSCs Biomanufacturing
· Derived analytical and numerical models on relevant thermofluid transport phenomena and cellular metabolic kinetics, to establish design principles for laser-based cell bioprocessing.
· Optimized biological assays with induced-pluripotent stem cells to elucidate the distinctive molecular signatures underlying laser-induced cell death.
· Designed and built instrumentation to measure the physicochemical properties of biocompatible ceramic thin-films, and an optical set-up to visualize flow dynamics in cell-culture chambers.
· Streamlined fluorescent data quantification from bioprocess outputs with custom Python-based image processing pipelines.

Wyss Institute for Biologically Inspired Engineering July 2021 - May 2023
Postdoctoral Research Fellow

High-throughput, Micro-Patterned Organoid Systems
· Developed microfluidic droplet-based techniques for single-cell encapsulation with patterned extracellular matrix droplets, thus permitting high-throughput generation and screening of organoid systems.

Harvard University July 2021 - May 2023
Postdoctoral Research Fellow

Precision Nanoparticles for Drug Delivery via Microfluidic-enhanced Chaotic Mixing
· By extending upon chaotic micromixing principles, designed a novel microfluidic-based fluid mixer permitting the high-throughput and uniform synthesis of lipid nanoparticles for mRNA vaccine delivery.
· Developed mechanistic models for lipid nanoparticle assembly based on mass transport and population balance equations, thus facilitating a predictive framework to optimally synthesize lipid nanoparticles accordingly to the therapeutic target.

Massachusetts Institute of Technology September 2016 - June 2021
Graduate Student Researcher

On-Chip Engineered, Physiologically-Functional Lymphatic Vasculature
· Optimized the *in vitro*, angiogenic growth of lymphatic capillaries to mimic their *in vivo* morphology and function, in a versatile microfluidic platform implemented for disease models and drug screening.
· Developed analytical and computational models to study the relevant transport phenomena that drive protein drainage and inflammatory-immune signals by the engineered lymphatic vasculature.
· Collaborated with Amgen Inc. by the implementing on-chip lymphatics to screen and characterize vascular transport of their monoclonal antibody candidates. Based on measured parameters, developed a physiological-based pharmacokinetic (PBPK) framework predicting differences in bioavailability.
· Additional projects included computational modeling of novel microfluidic systems to recapitulate biomechanical stimuli (microvascular flow and oxygen-tension gradients) and predicting chemotactic gradients during brain cancer metastasis.

Harvard Medical School June 2015 - August 2015
Undergraduate Student Researcher

Engineered Flow-Activated Endothelial Cell Sensor for Atherosclerosis Studies
· Characterized a transcriptionally-activated cellular sensor capable of exhibiting a quantitative fluorescent response when endothelial cells are exposed to atherosclerosis-prone flow patterns,thus allowing real-time visualization of flow shear stress on cell physiology.
· Validated the versatility of the cell-based sensor as a fluorescent readout for screening drugs that protect against atherosclerosis in endothelial cells exposed to disease-promoting flow patterns.

Princeton University June 2014 - August 2014
Undergraduate Student Researcher

Characterizing Viscoelasticity of Bacterial Biofilms via Micro-Membrane Rheometry
· Designed a microfluidic-based rheometer capable of measuring the elasticity of bacterial biofilms by the application of fixed air pressure to a micro-membrane in contact with the biofilm channel.
· Developed a COMSOL-based finite element analysis model to estimate the elasticity of the bacterial biofilm, based on the experimental measurements of the resultant deformations to the applied pressures.

University of Puerto Rico at Mayaguez August 2013 - December 2015
Undergraduate Student Researcher

Adaptive Responses of Murine Osteoblasts Subjected to Coupled Mechanical Stimuli
· Analyzed the orientational response of the actin cytoskeleton and expression of focal adhesion complexes in murine osteoblasts as a result of simultaneous mechanical cues (matrix stiffness and cyclic tensional strain) to induce preferential cellular alignment for functional bone tissue constructs.

PEER-REVIEWED PUBLICATIONS

Google Scholar Profile

1. **J.C. Serrano**, M. Pavlovic, M.B. Gilbertsen, K. Janhke, D.A. Weitz, Precision Nanoparticles for Drug Delivery via Microfluidic-enhanced Chaotic Mixing. *Under Review.* (2024)
2. **J.C. Serrano**, M. Gillrie, R. Li, R.D. Kamm, Microfluidic-Based Reconstitution of Functional Lymphatic Microvasculature: Elucidating the Role of Lymphatics in Health and Disease. *Advanced Science.* (2023)
3. G. Offeddu, **J.C. Serrano**, J. Z. Wan, et al, Microphysiological endothelial models to characterize subcutaneous drug absorption. *ALTEX-Alternatives to animal experimentation.* (2022)
4. C. Hajal, Y. Shin, L. Li, **J.C. Serrano**, T. Jacks, R.D. Kamm, The CCL2-CCR2 astrocyte-cancer cell axis in tumor extravasation at the brain. *Science Advances.* (2021)
5. G. Offeddu*, **J.C. Serrano***, S.W. Chen, S.E. Shelton, Y. Shin, R.D. Kamm, MicroHeart: A Microfluidic Pump for Functional Vascular Culture in Microphysiological Systems. *Journal of Biomechanics.* (2021) *These authors contributed equally to this work.
6. **J.C. Serrano***, S. Gupta*, R.D. Kamm, M. Guo, In Pursuit of Designing Multicellular Engineered Living Systems: A Fluid Mechanical Perspective. *Annual Review of Fluid Mechanics.* (2021) *These authors contributed equally to this work.
7. C. Hajal, L. Ibrahim, **J.C. Serrano**, G. Offeddu, R.D. Kamm, The effects of luminal and transendothelial fluid flows on the extravasation and tissue invasion of tumor cells in a 3D in vitro microvascular platform. *Biomaterials.* (2020)
8. R. Koens, Y. Tabata, **J.C. Serrano**, S. Aratake, D. Yoshino, R.D. Kamm, K. Funmoto, Microfluidic platform for three-dimensional cell culture under spatiotemporal heterogeneity of oxygen tension. *APL Bioengineering.* (2020)
9. R. Li, **J.C. Serrano**, H. Xing, T.A. Lee, H. Azizgolshani, M. Zaman, R.D. Kamm, Interstitial flow promotes macrophage polarization toward an M2 phenotype. *Molecular Biology of Cell.* (2018)
10. T. Osaki, **J.C. Serrano**, R.D. Kamm, Cooperative Effects of Vascular Angiogenesis and Lymphangiogenesis. *Regenerative Engineering and Translational Medicine.* (2018)
11. **J.C. Serrano**, J. Cora-Cruz, N. Diffoot, P. Sundaram, Adaptive Responses of Murine Osteoblasts Subjected to Coupled Mechanical Stimuli. *Journal of the Mechanical Behavior of Biomedical Materials.* (2018)

INTELLECTUAL PROPERTY/PATENTS

- *Single-cell derived organoids in extracellular matrix droplets.* (PCT/US2023/083972)
- *Microphysiological Model of the Brain.* (PCT/US2024/013132)
- *Flexus Mixer: A microfluidic-based mixer for nanoparticle synthesis.* (US patent pending)
- *Optical Engine for Automated Cell Imaging and Bioprocessing.* (US patent pending)
- *Closed-Fluidic Cassette for Long-Term Cell Culture and Manipulation.* (US patent pending)

TECHNICAL STRENGTHS

Programming Languages:	Python, MATLAB, R, Phoenix NLME, Monolix-PKanalix, LabVIEW, LaTeX
Simulation-Modeling:	ODEs/PDEs, Compartmental (Lumped-Element), Deep Learning (PINNs), Finite Element (COMSOL, Ansys)
Microscopy:	Confocal, Epifluorescence, High-speed/Time-Lapse
Molecular Biology:	PCR, Immunofluorescence, Flow Cytometry, ELISA, Western Blot
Microfabrication:	AutoCAD, Photo/Soft-lithography, Micromachining, 3D Printing
Culturing and Handling:	Mammalian Cells & Tissue, Bacteria

AWARDS AND HONORS

Invited Keynote Speaker: FluidicMEMS Consortium, Cambridge M.A. *(2024)*

El Mundo Boston's Latino 30 under 30 *(2022)*

MIT University Center for Exemplary Mentoring (UCEM) Sloan Scholar *(2018)*

National Science Foundation (NSF) Graduate Research Fellowship *(2017)*

MIT Office of the Dean for Graduate Education (ODGE) Diversity Fellowship *(2016)*

NIH RISE 2 BEST Program *(2013 - 2016)*

LANGUAGES

English:	native, bilingual proficiency
Spanish:	native, bilingual proficiency
French:	intermediate proficiency