

# Manoja Rajalakshmi Aravindakshan

☎ (+1) 7657019533 | ✉ manojalax@gmail.com | 🌐 mra | in manojalax | maravind@purdue.edu

## Research Interests

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- Lumped parameter cardiovascular modeling to simulate and predict fluid flow in the whole body
- Digital twins to study drug behavior (using organ-on-chip devices) and clinical outcomes

## Research/Work Experience

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### Purdue University

West Lafayette, USA

POSTDOCTORAL RESEARCH ASSOCIATE, SCHOOL OF MECHANICAL ENGINEERING

Feb 2025 - Present

- Working on reduced order modeling of the whole-body circulatory system in Vlachos research group.
- A comprehensive computational framework for whole-body lymphatic transport simulation
- A complete central nervous system fluid flow model including cranial and spinal CSF flow

OVERSEAS VISITING DOCTORAL FELLOW, COMPUTER SCIENCE

Aug 2023 - Jan 2025

- Blood flow-electrical system analogy for vessel resistance, compliance, and inertance for analysis of pressure and flow rates in circulatory system
- Comprehensive whole-body model for facilitating pharmacokinetic studies in cardiac diseases
- Digital liver-on-chip simulator (DigiLoCs) for drug distribution in liver-on-chip

### Indian Institute of Technology Kharagpur

West Bengal, India

RESEARCH SCHOLAR

Aug 2019 - May 2022

- Physiologically based pharmacokinetic (PBPK) modeling of drug distribution in liver-on-chip devices
  - Compartmental ODE model for simulating drug distribution through the integration of biological factors, hardware, and drug properties
  - Enhanced human clearance prediction through differentiation of active and passive processes across liver-on-chip platforms
  - *In vitro* to *in vivo* extrapolation for bridging *in vitro* findings with clinical relevance
- Computational approaches to insulin-glucose modeling and characterizing subtypes in type 2 diabetes
  - An extended insulin-glucose system including the role of adipokines (leptin) and BMI
  - Identified three distinct patho-clinical clusters among uncontrolled type 2 diabetes patients using data from a community health clinic
- Teaching Assistant: Foundations of Computing Science (CS60005), Algorithm Design and Analysis (CS60007), Computer Organization and Architecture (CS31001), Algorithms (CS21003)

SPONSORED RESEARCH AND INDUSTRIAL CONSULTANCY, IIT KHARAGPUR

Aug 2019 - Dec 2022

- Railway research projects by MHRD, India (IMP/2018/000471) Incorporating cab-signaling into interlocked signaling design with verification (IMPRINT-2) sponsored by SERB.
- Developed a commercially significant software (used by the zonal signalling sections of Indian Railways) to capture the layout and identify all possible routes and generate route control charts
- Programmed key modules in project “Software for Maintaining Institutes of Learning and Education (SMILE)”, sponsored by World Bank under TEQIP III (Ministry of Education, MHRD), Govt. of India)

## Embedon Global Energy Pvt Ltd

SOFTWARE ENGINEER

Pune, India

Nov 2016 - June 2018

- Developed code for embedded system projects including (i) Interactive games for cardio by simulating light patterns using sensors (ii) Software for three-dimensional marking machine that permanently marks components

## Internship

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### esqLABS GmbH

RESEARCH INTERN

Saterland, Germany

June 2023 - Dec 2023

- Developed scripts and software that describe digital twins for *in vitro* (organ-on-chip, 3D spheroids) systems
- Improved prediction of clinical outcomes to reduce time, costs and patient burden in drug development

### Metflux Research Pvt Ltd

RESEARCH INTERN

Mumbai, India

Aug 2021 - Dec 2021

- Worked on the adult metabolism model with diet perturbation
- Simulated effect of diet on body weight to gain physiological insight of metabolism in the body

### AAIC Technologies Pvt Ltd

SOFTWARE DEVELOPER INTERN

Hyderabad, India

Mar 2020 - July 2020

- GATE and machine learning course software, mentoring students and course content updation

### Gate Overflow

MENTOR AT Q/A SITE FOR COMPUTER SCIENCE

Trivandrum, India

Aug 2019 - Feb 2020

- GATE Q/A book for computer science, mentoring and solving problems to enhance learning experience

## Academics

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### Indian Institute of Technology Kharagpur

PHD IN COMPUTER SCIENCE, GPA: 9.28/10.0

Department of Computer Science and Engineering

West Bengal, India

Jan 2020 - Dec 2024

- **PhD thesis** Application of computational modeling towards digital twinning of human physiological and biochemical processes
- **Coursework** Systems Biology, Computational Structural Biology, Applied Multivariate Statistical Modelling, Machine Learning, Deep Learning

### Government Engineering College, Palakkad

BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE, GPA: 8.54/10.0

University of Calicut

Palakkad, India

Aug 2012 - May 2016

## Publications/Patents

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- DigiLoCS: A leap forward in predictive organ-on-chip simulations. PLoS ONE 20(1): e0314083. doi:10.1371/journal.pone.0314083 (2025)
- System for design of Route Control Chart (RCC) and application logic for interlocked signaling, patent application no. 202431029893, filed on Apr, 2024
- Parameter estimation for the oral minimal model and parameter distinctions between obese and non-obese type 2 diabetes. DNA and Cell Biology Reports. doi:10.1089dcbr.2024.0018 (2024)
- Distinct patho-clinical clusters among uncontrolled type 2 diabetes patients: results from a prospective study in rural India. BMJ Open Diab Res Care. doi:10.1136/bmjdr-2021-002654 (2022)
- A closed-loop lumped parameter model for whole-body cardiovascular simulation (submitted)
- A comprehensive computational framework for whole-body lymphatic transport simulation (submission-ready)
- An integrated lumped parameter framework for the circulatory system with detailed cerebral fluid flow (working paper)

## Skills/Certifications

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**Frameworks & Tools** Python (JAX), MATLAB, TensorFlow, RStudio, PK-Sim

**Certifications** Professional development, Purdue University; NPTEL Deep Learning Course (Top 1%)

**Extracurricular** Trained Carnatic vocalist, yoga and strength training

## Conferences/Workshops

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- “Lumped parameter model for simulating brain-body fluid dynamics: integration of CNS and whole-body circulatory systems”, 10<sup>th</sup> International Biofluid Mechanics and Mechanobiology Symposium (IBMS 10), Sep 5-7 UC Irvine, CA, USA
- “A whole-body lumped parameter model for cardiovascular simulation”, 18<sup>th</sup> U.S. Association for Computational Mechanics 2025, July 20-24, Chicago, IL, USA
- Talk on “Application of computational modeling towards digital twinning for human physiological systems” at *OVDF Symposium*, Purdue University, Dec 2024, IN, USA
- Talk on “Digital twins for liver-on-chip device” at *Data-driven mechanistic models of complex biomedical systems* workshop at University of Birmingham, UK (Dec 2023)
- “Parameter estimation for the oral minimal model and parameter distinctions between obese and non-obese type 2 diabetes”, *Bioinformatics and Computational Biology Conference, BBCC* (Dec 2022)

## Achievements

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- Awarded India’s Science and Engineering Research Board (SERB) *Overseas Visiting Doctoral Fellowship (OVDF)* at Purdue University (Aug 2023) with a total grant of USD 38,000
- Awarded *Metflux research internship 2021* for aspiring computational biologists
- Opportunity to work on project *Online Despatch System for Fabrication and T&E of AVN Packages* at Vikram Sarabhai Space Centre, Trivandrum
- Rank holder in Calicut University and Batch topper award-Computer Science, 2016

## References

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### **Pavlos Vlachos**

Professor  
School of Mechanical Engineering  
Purdue University  
pvlachos@purdue.edu

### **Chittaranjan Mandal**

Professor  
Computer Science and Engg  
IIT Kharagpur  
chitta@iitkgp.ac.in

### **Alex Pothen**

Professor  
Computer Science  
Purdue University  
apothen@purdue.edu