BHAVYA BALU

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Carnegie Mellon University (CMU) Pittsburgh, PA
Doctor of Philosophy in Chemical Engineering (**GPA:** 3.8/4.0) *Anticipated May 2021*
Research: Mathematical modelling of charge transport dynamics in electrochemical and electrokinetic systems

Indian Institute of Technology Madras Chennai, India
Bachelor of Technology (with Honors) in Chemical Engineering (**GPA:** 8.9/10.0) *May 2016*
Research: Computational modelling of droplet behavior in 2D microchannels

THESIS

Carnegie Mellon University Pittsburgh, PA
Advisor: Prof. Aditya S. Khair

Thesis title: Mathematical modelling of charge transport dynamics in asymmetric electrolytes

- Diffusiophoretic velocity of particles in asymmetric electrolytes at arbitrary Debye lengths *Aug 2020 - present*
  - Derived analytically the diffusiophoretic velocity of a charged colloidal particle in a salt concentration gradient
  - Generalized theory to include the effect of unequal ion valences and arbitrary screening lengths
- Phoretic particle motion in asymmetric rectified electric fields *Jan 2020 - Jul 2020*
  - Formulated analytically the nonlinear response of an asymmetric electrolyte under an ac voltage
  - Predicted time averaged velocity of a colloidal particle in electrolyte due to such a rectified electric field
- Dynamic double layer force between two surfaces in electrolyte *Apr 2019 - Dec 2019*
  - Developed new theory describing non-equilibrium force between two electrodes under a time dependent voltage
  - Estimated non-equilibrium force that is orders of magnitude larger than the equilibrium value
- Lift force on a charged sphere that translates and rotates in an electrolyte *Dec 2018 - Jan 2019*
  - Explained deflection of charged spheres in microchannel flow as observed by previous experiments
  - Solved numerically the coupled boundary value problem for the electrokinetics and fluid dynamics
- Role of Stefan-Maxwell fluxes in the dynamics of concentrated electrolytes *Jan 2017 - July 2018*
  - Formulated modified governing equations for ion transport dynamics in concentrated electrolytes
  - Extracted the time scales for charging of an electrochemical cell using asymptotic analysis

LEADERSHIP ROLES

Department Representative, Graduate Student Assembly, CMU *Jan 2020 - present*
- Voice concerns of the student body, vote on allocation of funds, and serve on graduate action committees

Outreach Coordinator, Chemical Engineering Graduate Student Association, CMU *Jan 2019 - Dec 2019*
- Initiated a series of outdoor community outreach events that drew twice the number of volunteers than previous years
- Coordinated a food drive, fundraising campaign (raised $600), and volunteers for local STEM outreach.

Co-organizer, Chemical Engineering Industrial Career Seminar, CMU *May 2019 - May 2020*
- Organized 2 one-day professional development events inviting 5-6 industry professionals and senior graduate students

Alumni Affairs Secretary, Sharavati Hostel, Indian Institute of Technology Madras *Aug 2014 - May 2015*
- Organized fundraisers, maintained alumni database and website, and held events for the graduating class of the hostel

FELLOWSHIPS & AWARDS

Toor Fellowship in Chemical Engineering, 2020; Mahmood I. Bhutta Fellowship in Chemical Engineering, 2019; Dean's Fellowship, 2016-17; MITACS Globalink Research Fellowship, 2015.

SKILLS

Analytical Tools: Perturbation methods, asymptotic analysis, Laplace & Fourier transforms for partial differential equations
Languages and Software: Python, C/C++, MATALB, COMSOL, Microsoft Excel, Inkscape

ADDITIONAL RESEARCH EXPERIENCE

Bachelor's Thesis Project, Indian Institute of Technology Madras — Chennai, India
Advisor: Prof. Raghunathan Rengaswamy
Thesis title: Destabilization due to coalescence in 2D poly-disperse micro-emulsions — *Aug 2015 - April 2016*
- Extended a stochastic model for coalescence destabilization of mono-disperse micro-emulsions to include poly-dispersity

MITACS Globalink Research Internship, University of Alberta — Edmonton, Alberta
Advisor: Prof. Aloke Kumar
Project title: Modelling fluid flow through porous media — *May 2015 - Aug 2015*
- Developed a computational model using COMSOL and conducted a parameter study for fluid flow through porous media

PROFESSIONAL EXPERIENCE

Summer Internship, Forbes Marshall — Chennai, India
Project title: Energy analysis of an autoclaved aerated concrete block plant — *May 2014 - Aug 2014*
- Built a spreadsheet model to analyze the steam and power consumption in an AAC block manufacturing plant

PUBLICATIONS

- **B. Balu** and A. S. Khair, "A thin double layer analysis of asymmetric rectified electric fields (AREFs)", *submitted*
- A. S. Khair and **B. Balu**, "Breaking electrolyte symmetry in induced-charge electro-osmosis", *Journal of Fluid Mechanics (2020), 905, A20*
- **B. Balu** and A. S. Khair, "Dynamic double layer force between charged surfaces", *Physical Review Research 2.1 (2020): 013138*
- A. S. Khair and **B. Balu**, "The lift force on a charged sphere that translates and rotates in an electrolyte", *Electrophoresis 40.18-19 (2019): 2407-2414*
- **B. Balu** and A. S. Khair, "Role of Stefan-Maxwell fluxes in the dynamics of concentrated electrolytes", *Soft Matter 14.41 (2018): 8267-8275*

CONFERENCES

- **B. Balu** and A. S. Khair, "Particle motion in asymmetric rectified electric fields", *Annual Meeting of the American Institute of Chemical Engineers*, virtual conference, 19 November 2020, full length talk
- **B. Balu** and A. S. Khair, "Dynamic double layer force between charged surfaces", *Annual Meeting of the American Institute of Chemical Engineers*, virtual conference, 20 November 2020, full length talk
- **B. Balu** and A. S. Khair, "Role of Stefan-Maxwell fluxes in they dynamics of concentrated electrolytes", *International Symposium on Electrokinetics*, Boston, MA, 12 June 2019, poster with soundbite
- **B. Balu** and A. S. Khair, "Role of Stefan-Maxwell fluxes in they dynamics of concentrated electrolytes", *Annual Meeting of the American Institute of Chemical Engineers*, Pittsburgh, PA, 1 November 2018, full length talk
- P. Sivakumar, **B. Balu**, M. Danny Raj, R. Rengaswamy, "Soft matter meets machine learning: insights into the stability of poly-disperse emulsions", *CompFlu-'17*, Chennai, India, December 2017, contributed work

MENTORING & SERVICE

- Volunteer, Moving 4th into Engineering, Pittsburgh, PA — *Apr 2019*
- Essay & Presentation Judge at Future City Regional Competition, Pittsburgh, PA — *Jan 2019*
- Poster Judge at the Annual Meeting of the American Institute of Chemical Engineers, Pittsburgh, PA — *Nov 2018*
- Project mentor to Summer Undergraduate Research Intern at CMU — *Summer 2018*
- Teaching Assistant, Physical Chemistry of Colloids and Interfaces, graduate course, CMU — *Spring 2018*
- Teaching Assistant, Mathematical Techniques in Chemical Engineering, doctoral course, CMU — *Fall 2017*
- Teaching Assistant, Mathematical Methods of Chemical Engineering, sophomore course, CMU — *Spring 2017*
- Volunteer, Engineers Week at the Carnegie Science Center, Pittsburgh PA — *Feb 2017*