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Education

Jul. 2015 – Present	Doctorate degree	<i>Indian Institute of Technology Madras, India</i>
Aug 2011–May 2015	Bachelor of Technology	<i>Vellore Institute of Technology, India</i>

Research Experience

- 2019-2020 **Self-diffusiophoresis in complex medium**
Self-diffusiophoretic Janus particles can create concentration gradient along their surface. This induces a diffusio-osmotic slip across the tangential direction, which generates a force-free motion. These particles have potential applications in bio-sensing and imaging processes and since most biological fluids exhibit non-Newtonian behavior, the work was motivated to understand the effect of complex rheology on self-propulsion. Using matched asymptotic expansions, this study provided analytical expressions for the modification of diffusio-osmotic slip induced by the non-Newtonian behavior: viscoelastic and shear-thinning effects. Through the derivations of analytical expressions in each case, it was demonstrated that the relationship of concentration gradient with the slip velocity is fundamentally different in complex fluids compared to that in Newtonian fluid. These results were later used to investigate the modification in swimming velocity.
- 2018-2019 **Inertial migration of electrophoretic particles in confined Newtonian flows**
The presence of inertia in a pressure-driven flow imparts a cross-stream force on freely suspended particles, which results in their lateral migration at certain equilibrium positions. An application of electric fields provides an external control to tune these equilibrium positions. The theoretical study provided analytical results for the additional cross-stream lift force which acts due to the coupling of electrokinetic and inertial effects. The effect of confinement substantially alters the hydrodynamic lift and provides additional wall-repulsive Maxwell stress-induced lift. Earlier experimental studies had hypothesized this unknown additional force to be similar to that acting due to buoyancy effects (i.e. Saffman lift). To demonstrate that a direct analogy cannot be made, the study further revealed the fundamental differences between the electrokinetics-induced migration and buoyancy-induced migration.
- 2019 **Migration of an electrophoretic particle in confined viscoelastic flows**
The theoretical framework developed in the previous analysis was employed to study the cross-stream migration in viscoelastic pressure-driven flow. The study revealed that the interaction between electrokinetics and normal stresses (due to non-linear bulk rheology) result in an additional lateral force, which is an order of magnitude larger than that arising from pure normal stresses. The study found a good agreement of the theoretical predictions with the experiments performed by D. Li and X. Xuan (Clemson University, USA). An order of magnitude enhancement in focusing offers potential application in efficient cell-sorting in lab-on-chip devices.

2016-2017 **Reactive and mass transport in curved microchannels**
 Microchannels with porous walls are used for controlled heterogeneous reactions over catalyst embedded in the annular region of membranous microchannel. Motivated by the process intensification experiments on spiral and serpentine membrane reactors, I studied the impact of curvature on the yield. Flow through curved geometries generates Dean vortices, which aid in transversal mixing of reactants and products diffusing through the walls. The fully developed flow field through curved channel was found both analytically (using perturbation methods) and numerically. By formulating a Finite difference based CFD model, I simulated the transport in microreactor environment (both flow and membrane domain of finite thickness) and quantified the enhancement in mass transport.

May2017-Aug.2017 **Transport in microreactors (Visiting Scholar)**
 The above work led to an international collaboration with the experimental group of Prof. Roland Dittmeyer (Karlsruhe Institute of Technology, Germany). I spent 3 months at KIT (May-Aug.2017), building a numerical model that captures reactive and mass transport of hydrogen peroxide in microreactors. I also simulated capillary condensation of heavy hydrocarbons in cylindrical catalytic pores. Through a dynamic model, I studied the evolution of accumulated hydrocarbons in the pore and demonstrated the competition between evaporation and condensation of hydrocarbons.

Awards and Scholarships

Jul. 2020 – Present	Institute pre-doctoral fellowship awarded by Indian Institute of Technology Madras
Dec. 2019	Best poster presentation award at 13 th International Conference on Complex Fluids and Soft Matter held in Indian Institute of Science Education and Research, Bhopal
Mar. 2017 & 18	Awarded for best presentation at the Annual research symposium held in Indian Institute of Technology Madras
Mar. 2016	Awarded for best poster at the Annual research symposium held in Indian Institute of Technology Madras
May 2015 – Jul 2020	PhD fellowship awarded by Indian Ministry of Human Resource Development

Mentoring Experience

Aug. 2019 – Present	K. K. Faseeh	Computational modeling of transport through curved serpentine channels (In collaboration with Prof. Roland Dittmeyer, IMVT-KIT, Germany)
Jan. 2018 – Jun. 2019	Farzin Kandath	
Jan. 2019 – Present	Prathmesh Vinze	<ol style="list-style-type: none"> 1. Inertial migration at high Reynolds numbers. 2. Electrolytic and non-electrolytic self-diffusiophoresis in chemical gradients.

Teaching Experience

- Jan.–May (2020) Graduate level course on *Multiphase Flows* (IIT Madras, India). Apart from teaching assistance, I delivered total of eight lectures on regular and singular perturbation theory.
- Jul.–Nov. (2017,18) Graduate level course on *Steady State and Dynamical Systems* (IIT Madras, India). I delivered three lectures on the applications of linear stability analysis. Conducted several workshops on using MATLAB and MatCont for dynamical analysis.
- Jan.–May (2017,18) Graduate level course on *Mathematical methods in Chemical Engineering* (IIT Madras, India). In addition to teaching assistance, ER delivered total of ten lectures on applications of Sturm–Liouville theory and Green’s function.
- Jul.–Nov. (2016) Teaching assistant for Graduate level tutorial sessions on using MATLAB and ASPEN software for chemical engineering applications (IIT Madras, India).

Other Research Activities

- 21-23 Sep. 2020 **Coordinator & instructor** for a 3-day online workshop on *Introduction to process simulation using Scilab* for the students affiliated to Chhattisgarh Swami Vivekanand Technical University Bilai.
- 3 Mar. 2020 **Instructor** for a workshop on *Introduction to Symbolic Computing using Mathematica* during the Annual Research Symposium held at Indian Institute of Technology Madras.
- Sep. 2017 – Jan. 2019 **Organizer**, *Fluids in Engineering and Nature* seminar series, Indian Institute of Technology Madras
- 2020 **Reviewer** for 26th International Symposium on Chemical Reaction Engineering (ISCRE)

Presentations (Conferences and Invited Seminars)

- 6 Dec. 2019 *Autophoretic propulsion in complex fluids* at 13th International Conference on Complex Fluids and Soft Matter held in IISER Bhopal.
- 26 Nov. 2019 *Electrokinetically enhanced cross-stream particle migration in viscoelastic flows* at 72nd international American Physical Society-DFD meet, Seattle.
- 25 Nov. 2019 *Non-Newtonian effects on the slip and mobility of a self-propelling active particle* at 72nd international American Physical Society-DFD meet, Seattle.
- 21 Nov. 2019 Invited talk on *Electric field enhanced migration in Newtonian and non-Newtonian flows* at Department of Chemical Engineering, University of Florida, Gainesville.
- 12 Nov. 2019 *Lateral migration of an electrophoretic particle in Newtonian and viscoelastic pressure driven flows* at AIChE Annual Meet, Orlando.
- 8 Dec. 2018 *Inertial migration of an electrophoretic rigid sphere in a Poiseuille flow* at 12th International Conference on Complex Fluids and Soft Matter held in IIT Roorkee.

- 19 Nov. 2018 *Inertial migration of an electrophoretic rigid sphere in an electroosmotic-Poiseuille flow* at 71st international American Physical Society-DFD meet, Atlanta.
- 18 Dec. 2017 *Potential application of inertial migration in microreactors* at 11th International Conference on Complex Fluids and Soft Matter held in IIT Madras.
- 30 Aug. 2017 Invited talk on *Modelling the direct synthesis of hydrogen peroxide in a serpentine membrane microreactor* on Fluids Day held in IIT Madras.
- 12 Dec. 2016 *On the effect of Dean vortices on gas-liquid reactions in membranous microchannels* at 10th International Conference on Complex Fluids and Soft Matter held in IIT Hyderabad.

Peer-Reviewed Publications

- May 2020 **A. Choudhary**, T. Renganathan and S. Pushpavanam.
Non-Newtonian effects on the slip and mobility of a self-propelling active particle, Journal of Fluid Mechanics 899
- May 2020 **A. Choudhary**, Di Li, T. Renganathan, X. Xuan and S. Pushpavanam.
Electrokinetically enhanced cross-stream particle migration in viscoelastic flows, Journal of Fluid Mechanics 898
—Also featured in a popular science format on alumni.iitm.ac.in/tech-talk titled ‘*Membraneless Particle Separation via Electric Fields: Towards on-site Disease Detection*’
- Jun. 2019 **A. Choudhary**, T. Renganathan and S. Pushpavanam.
Inertial migration of an electrophoretic rigid sphere in a 2D Poiseuille flow, Journal of Fluid Mechanics 874
- Sep. 2017 **A. Choudhary** and S. Pushpavanam.
Process intensification by exploiting Dean vortices in catalytic membrane microreactors, Chemical Engineering Science 174
- Jul. 2017 C. Sun, Z. Luo, **A. Choudhary**, P. Pfeifer and R. Dittmeyer.
Influence of the Condensable Hydrocarbons on an Integrated Fischer-Tropsch Synthesis and Hydrocracking Process: Simulation and Experimental Validation, Industrial & Engineering Chemistry Research 56.45

Under Review

- Sub: Sep. 2020 **A. Choudhary**, T. Renganathan and S. Pushpavanam.
Comment on "Migration of an electrophoretic particle in weakly inertial or viscoelastic shear flow", Physical Review Fluids

Upcoming Presentations

- 23 Nov. 2020 **A. Choudhary**, K.V.S Chaithanya, S. Michelin and S. Pushpavanam.
Motion of Janus sphere in two-dimensional confinement
73rd Annual Meeting of the APS Division of Fluid Dynamics
- 24 Nov. 2020 P.M. Vinze, **A. Choudhary** and S. Pushpavanam.
Motion of an active particle in linear concentration gradients
73rd Annual Meeting of the APS Division of Fluid Dynamics