Prathamesh Kulkarni

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EDUCATION

Ph.D. in Chemical and Biomolecular Engineering, GPA: 3.95/4.00   Fall 2019 − Present
Rice University   *Houston, TX*

B.Tech. Chemical Engineering, CPI: 8.10/10.00   2019
Indian Institute of Technology (IIT) Bombay   *Mumbai, India*

SKILLS

Professional Summary: Trained chemical engineer with **5+ years of experience** in computational modeling using statistical mechanics/thermodynamics, biological physics, soft matter rheology, and chemical reaction engineering

Programming: C++, Python, Bash, High Performance Computing (SLURM) for remote parallel processing

Physics-based and Soft Matter Modeling: Coarse-grained simulations using lattice-based geometry and off-lattice models to predict strain-stiffening, stress-relaxation, fragmentation of soft elastic materials

Chemical Engineering & ODE/PDE Modeling: Monte-Carlo techniques, Stochastic processes, Brownian dynamics for particle-based simulations like gas-liquid phase equilibria, Differential equations (ODE/PDE) for modeling flow/fluid mechanics and thermodynamics, chemical kinetics for reaction engineering modeling

Publishing: LaTeX, Microsoft Office, Inkscape, Data Visualization with Python (Matplotlib) and MATLAB

WORK EXPERIENCE

PhD Candidate, Rice University   Houston Texas
Advisors: Dr. Frederick MacKintosh and Dr. Anatoly Kolomeisky   *Spring 2020 - Present*

- Gained hands-on expertise in coarse-grained modeling of soft crosslinked biopolymers using (triangular)lattice and off-lattice fiber-network simulations(C++), stress/strain, rheological analysis for material mechanical response
- Modeled mechanochemical feedback (force-dependent fiber severing) and showed how stress relaxation/shift in rigidity thresholds influences material lifetime and tunable mechanical response in soft materials and tissues
- Demonstrated orders of magnitude increase in shear modulus of biopolymer composites with "rope-like" filaments and shift in onset of rigidity/material stiffening to lower strains enabling requirement-specific material design
- Automated large parametric space sweeps using Bash scripts on SLURM-managed High Performance Computing clusters to execute large-scale parallel C++ simulations and post-processing/visualization in MATLAB

Undergraduate Research Assistant, Indian Institute of Technology Bombay   Mumbai, India
Advisor: Dr. Supreet Saini, Department of Chemical Engineering   *Dec 2017 − Feb 2018*

- Performed stochastic simulations tracking how cost/benefit trade-offs and response accuracy shape population fitness when conditioning is allowed in bacterial population under stochastic signal detection
- Formulated non-linear optimization of cell growth, degradation, and kinetic parameters to identify benefits of conditioning in bacterial population

ACADEMIC PROJECTS

Robophysics Bootcamp   Atlanta, GA
Goldman Lab, Georgia Institute of Technology   *14-16 Jul 2025*

- Assembled and Arduino-programmed 5-linker robot with servo motors, quantified distance traveled-per-cycle scaling to test geometric-phase effects on locomotion - intersection of robotics and soft matter

Phase Equilibria using Gibbs Ensemble Monte Carlo   Houston, TX
Advisor: Dr. Walter Chapman, Rice University   *Fall 2019*

- Applied thermodynamic modeling principles and Monte Carlo methods to predict gas–liquid equilibrium for a model fluid: key design parameter for chemical processes
- Investigated phase separation and density profiles near critical points with literature comparison crucial for oil/gas, chemical, and pharmaceutical process design

Transient exposure of protein binding DNA sites in the nucleosome   Mumbai, India
Advisor: Dr. Ranjeeth Padinhateeri, Biosciences and Bioengineering, Indian Institute of Technology Bombay   *Spring 2018*

- Developed bead-spring Brownian-dynamics simulations for DNA–histone nucleosomes, implementing Langevin integration with Morse and electrostatic potentials to simulate spontaneous partial unwrapping - project for a graduate-level course that focused on computational biology modeling

Growth-related Modeling of the GAL System in yeasts -*S. cerevisiae* And *K. lactis*　　　Mumbai, India

Advisors: Dr. Sharad Bhartiya and Dr. K. V. Venkatesh, Department of Chemical Engineering　　*Aug 2018 − Apr 2019*

- Reproduced the existing growth-associated dynamic model for GAL gene regulatory network in *S. cerevisiae* growing on glucose and galactose using differential equations for associated reaction kinetics
- Explored and modeled the growth-burden tradeoff due to synthesis of GAL proteins in *S. cerevisiae* and *K. Lactis*

PUBLICATIONS

Kulkarni, P., Kolomeisky, A. B., MacKintosh, F. C., Stress relaxation in spring networks via force-dependent stochastic severing (In preparation)

Kulkarni, P., Gupta, S., Kolomeisky, A. B., MacKintosh, F. C., Mechanics of composite networks with rope-like filament (In preparation) (Website: prathameshk867.github.io)

TALKS AND POSTER PRESENTATIONS (SELECTED)

Presented a poster on Stress relaxation in spring networks via force-dependent stochastic severing at the Smalley Curl Institute Colloquium 2024 (Best poster award)

Presented a talk on Mechanics of composite networks with rope-like filaments at the Global Summit (March Meeting) of the American Physical Society 2025: talk abstract link

LEADERSHIP AND OUTREACH

Outreach Chair — Rice University　　　Houston Texas

ChBE Graduate Student Association (ChBE GSA)　　*Jun 2021 − Jun 2022*

- Acted as a liaison between ChBE GSA, AIChE,and ChBE Alumni committee and helped organize career fair preparation events such as Resume review, Mock Interviews, Fishbowl interview, and Career Panel for students

Treasurer — Rice University　　　Houston Texas

ChBE Graduate Student Association (ChBE GSA)　　*Jun 2020 − Jun 2021*

- Managed the budget of ChBE GSA and applied for grants to support social events virtually for graduate student engagement and morale during the pandemic

Events Manager, Indian Institute of Technology Bombay　　　Mumbai, India

AZeotropy - Chemical Engineering Symposium　　*Apr 2017 − March 2018*

- Coordinated a 2-tier team to conceptualize and execute 20+ events—lectures, panel discussions, exhibitions, and fireside chats—in partnership with industry and academic leaders, drawing over 2000 attendees
- Organized hands-on workshops on engineering simulation software (ASPEN, ANSYS, COMSOL, MATLAB) - creating educational opportunities for students to learn modeling outside of the curriculum

TEACHING EXPERIENCE

Teaching Assistant for Fluid Mechanics and Transport Phenomena CHBE 501　　*Fall 2021, 2022*
Teaching Assistant for Computational Methods in Chemical Engineering　　*Spring 2020*
Teaching Assistant for Thermodynamics I, ChBE 411　　*Spring 2023*

- Held office hours weekly to guide students and clarify concepts outside of class, and graded assignments for first-year 30+ graduate students and programming assignments for undergraduate students

INDUSTRIAL TRAINING

Modeling and Simulation of Catalytic Converter　　　Pune, India

Instructor: Harsh Vinjamoor, Manager R&D SEDEMAC Mechatronics　　*May 2017 − Jul 2017*

- Analyzed the chemical reaction kinetics involved in catalytic converter and simulated surface reactions via Python
- Studied and attempted to replicate outlet gas concentration profiles variations with changes to air-to-fuel ratio at the inlet of catalytic converter - valuable understanding to design emission control strategies

AWARDS & ACHIEVEMENTS

Recipient of Graduate Student Travel Grant award by Rice Engineering Alumni (REA)　　*Spring 2025*

Recipient of Platinum Poster Award at the Smalley Curl Institute Colloquium　　*Summer 2024*

Honored with Undergraduate Research Award for exemplary contribution to research　　*2018*

Awarded Department Color for exceptional contribution to the chemical engineering symposium activities　　*2018*

RELEVANT COURSEWORK AND WORKSHOPS

Chemical Engineering, Computational Biology, and Modeling: Fluids and Transport Phenomena, Statistical Mechanics, Advanced Numerical Methods, Modeling Biological Systems and Processes, Physicochemical Hydrodynamics