Dipanjan Ghosh

CONTACT INFORMATION

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RESEARCH INTERESTS

Computational Molecular Sciences, Soft Condensed Matter, Fluid Dynamics, Bayesian Data Analysis

EDUCATION

Jadavpur University *July 2014 – present*
Bachelor of Engineering, Chemical Engineering

- Cumulative Grade Point Average (CGPA): **9.06/10.00**

West Bengal Council of Higher Secondary Education (+2 Intermediate) *May 2014*

- Scored **93.2%** aggregate, **97%** in Sciences and Mathematics

West Bengal Board of Secondary Education *May 2012*

- Scored **90.4%** aggregate, **97%** in Sciences and Mathematics

STANDARDIZED TESTS

Graduate Record Examinations (GRE) General Test **327/340**
Verbal Reasoning: **158/170** Quantitative Reasoning: **169/170** Analytical Writing: **5.5/6.0**

PERSONAL ACHIEVEMENTS

- Awarded the prestigious **S. N. Bose Fellowship** to pursue undergraduate research at Massachusetts Institute of Technology, USA for the summer of 2017
- Recipient of **I. Putatunda & S. Putatunda gold medal** for highest CGPA among sophomores in Chemical Engineering in the year 2015-16
- Secured **11$^{\text{th}}$** rank among approximately 1 million candidates in the +2 Intermediate Examination conducted by the West Bengal Council of Higher Secondary Education in 2014
- Ranked **1$^{\text{st}}$** in three out of six semesters in the Department of Chemical Engineering, Jadavpur University. Currently ranked **2$^{\text{nd}}$** among 90 students in the department

PUBLICATIONS

[1] ***Fast Bayesian inference of the multivariate Ornstein-Uhlenbeck process [arXiv:1706.04961]***
R. Singh, **D. Ghosh**, R. Adhikari
Submitted to ***Physical Review E***

[2] ***Fast Bayesian inference of optical trap stiffness and particle diffusion [arXiv:1610.00315]***
S. Bera, S. Paul, R. Singh, **D. Ghosh**, A. Kundu, A. Banerjee, R. Adhikari
[Scientific Reports 7, 41638 (2017)]

RESEARCH PROJECTS

Swan Research Group, Massachusetts Institute of Technology, Cambridge, MA, USA
Phase behavior of dipolar colloidal particles
Supervised by Prof. James W. Swan *Summer 2017*

- This project aimed to construct a predictive theoretical framework for determining the equilibrium phase behavior of dielectric/paramagentic colloidal particles.
- Using Brownian dynamics simulations, the equilibrium structures of a system containing a million dipolar nanoparticles were investigated. The intensity of the external field as well as the conductivity ratio of the particles were varied and the corresponding changes in thermodynamic behavior were noted.
- Devised a data extraction procedure to efficiently extract coexisting liquid and crystal phase volume fractions along with corresponding dipole moments. The coexisting volume fractions were plotted against corresponding external field intensities to get a theoretical phase diagram for these field responsive nanoparticles.

– Learnt about molecular dynamics simulations on massively parallel architectures of graphics processing units (GPUs) and extraction and analysis of large volumes of data generated from trajectories of millions of particles.

Soft Matter Group, The Institute Of Mathematical Sciences, Chennai, India
Bayesian parameter estimation of multivariate Ornstein-Uhlenbeck process
Supervised by Prof. Ronojoy Adhikari *December 2016 - January 2017*

– This project aimed at extending an inference algorithm previously developed by this group for one dimensional Ornstein-Uhlenbeck processes to higher dimensions.
– Analytical expressions were computed for drift and diffusion matrices for a multivariate Ornstein-Uhlenbeck process. The developed algorithm was of linear complexity with respect to number of data points and outperforms existing inferential techniques for parameter estimation of Ornstein-Uhlenbeck process models.
– Demonstrated a physical application of our algorithm by developing a framework to estimate the mass of a nanoparticle performing underdamped Brownian motion in a harmonic trap from its position and velocity data.
– Developed an information theoretic framework to determine whether the Brownian motion of a particle in a harmonic trap is overdamped or underdamped by looking at its trajectory.

Bayesian parameter estimation for overdamped Brownian motion
Supervised by Prof. Ronojoy Adhikari *Summer 2016*

– This project involved modelling the overdamped Brownian motion of a particle confined in an optical trap as an Ornstein-Uhlenbeck process and estimating the mean regression rate and volatility of the process using Bayesian statistics.
– Exact likelihoods and sufficient statistics were used to arrive at simple analytical expressions for the optical trap stiffness and particle diffusion coefficient, and the advantage of this method over traditional power spectrum based methods were demonstrated.
– Devised a microscopic method of viscometry under the guidance of my supervisor, for determination of viscosity of fluids samples in the nanoliter range using the Bayesian estimate of particle diffusion coefficient.
– Familiarized myself with physical applications of stochastic processes and Bayesian data analysis.

Industrial Training

Rashtriya Chemicals and Fertilizers Limited, Mumbai *December 2015 - January 2016*
Student Trainee at Sulfuric Acid Plant and Ammonia Plant

– Acquainted myself with the detailed process parameters for the production of Sulfuric Acid using DCDA process.
– Developed a detailed understanding of the process parameters involved in the production of Ammonia and worked on a problem concerning the design of chillers and compressors in the Ammonia Refrigeration Circuit, under the supervision of the chief engineer.

Relevant Courses

- ***Chemical Engineering***: Fundamentals of Chemical Engineering, Chemical Process Calculations, Chemical Engineering Thermodynamics, Heat Transfer, Separation Processes- I,II&III, Chemical Reaction Engineering- I&II, Chemical Technology- I&II, Process Dynamics and Control.
- ***Fluid Dynamics***: Mechanics of Fluids, Introduction to Transport Phenomena.
- ***Computational Techniques***: Introduction to Computer Programming, Numerical Methods, Optimization Methods, Operations Research.
- ***Mathematics***: Real Analysis and Multivariate Calculus (Mathematics- I), Linear Algebra and Vector Calculus (Mathematics- II), Ordinary and Partial Differential Equations (Mathematics- III), Mathematical Methods in Chemical Engineering.
- ***Physics***: Optics and thermal physics, Basic Electronics.

- ***Chemistry***: Introduction to Quantum Mechanics (Inorganic Chemistry), Organic Chemistry, Electrochemistry and Surface Chemistry (Physical Chemistry), Materials Science and Engineering.

Skills

- ***Computational Tools***: MATLAB, GNU Octave
- ***Molecular Simulations Toolkit***: HOOMD-Blue
- ***Probabilistic Programming***: Stan
- ***Programming Languages***: C, C++, Python
- ***Other Tools***: LaTeX, Visual Molecular Dynamics