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Shishir Adhikari

PhD Candidate, Physics, Case Western Reserve University

Education

PhD, Physics — *Aug' 13 - Aug' 19 (Expected)*
Case Western Reserve University
Area: Biophysics
Advisor: Prof. Michael Hinczewski

MS, Physics Entrepreneurship — *Aug' 11 - Jul' 13*
Case Western Reserve University
Thesis: PLEXAR IMAGING: A Startup Determined To Solve Dose Variability Problem

BA, Physics, Minor: Computer Science, Mathematics — *Aug' 07 - Jul' 11*
magna cum laude
Hiram College

Research Interests

Non-equilibrium Statistical Mechanics, Biophysics, Machine learning

Publications

Shishir Adhikari, Jacob Moran, Christopher Weddle, Michael Hinczewski, "Unraveling the mechanism of the cadherin-catenin-actin catch bond" *PLoS Comput. Biol.* 14, e1006399 (2018)

Mark P. Taylor, Yuting Ye, **Shishir R. Adhikari**, "Conformation of a flexible polymer in explicit solvent: Accurate solvation potentials for Lennard-Jones chains" *J. Chem. Phys.* 143, 204901 (2015)

Mark P. Taylor, **Shishir R. Adhikari**, "Conformation of a flexible chain in explicit solvent: Exact solvation potentials for short Lennard-Jones chains" *J. Chem. Phys.* 135, 044903 (2011)

Awards & Achievements

Phi Beta Kappa (2011)
Magna Cum Laude (2011)
Applied Physics Departmental Honors (2011)
Global Trustee Scholarship (2007- 2011)
Ranney Webster Grant for Physics Research (Summer 2008)
Mahatma Gandhi Scholarship (2003-2005)

Research Projects

Physics of Machine Learning
Supervisors: Prof. Michael Hinczewski & Prof. Alkan Kabakcioglu — *Aug '18 - Present*

Questions:
- Is it possible to map machine learning to stochastic mechanics problem?
- What kind of mathematical formalism do we need to do so?
- How does the probability distribution of weights evolve?

Progress:
- In the process of writing a paper and submitting to a peer-reviewed journal.

Heterogeneity
Supervisor: Prof. Michael Hinczewski & Colleague: Tenglong Wang — *May '17 - Present*

One of the most intriguing results of single molecule experiments on proteins and nucleic acids is the discovery of functional heterogeneity: the observation that complex cellular machines exhibit multiple, biologically active conformations (states).

Questions:

- Given the experimental data, is it possible to figure out the multiple conformations?

Progress:

- Using Deep Neural Network, we have been able to figure out number of states in a simple fake systems.
- We are trying to use Bayesian nonparameteric model like infinite Hidden Markov Model(iHMM) as another method to solve this problem.

Modeling Triphasic Bonds

Supervisor: Prof. Michael Hinczewski & Colleague: Shamreen Iram *May '16 - Present*

Under the application of force, the bond lifetime of E-selectin-PSGL-1 behaves as slip-catch-slip. This behavior is termed as triphasic bond.

Questions:

- Is it possible to develop a physical model of triphasic bonds?

Progress:

- We have such a model and we are in a process of fitting experimental data to that model.

Modeling Catch Slip bond on Notch-Jag/DLL

Supervisor: Prof. Michael Hinczewski & Colleague: Marcus Lapeyrolerie *May '16 - Present*

In *PLoS Comput. Biol. 14, e1006399 (2018)*, we came with a physical model for catch bond. We asked the following question:

Questions:

- Is it possible to modify aforementioned work's model to understand catch & slip bond on Notch-Jag/DLL?

Progress:

- We found it possible to do so. We are in the process of validating our calculation by fitting the model to the experimental data.

Energetic Mechanism Behind Regulation of Catch Bonds Under Time Varying Force

Supervisor: Prof. Michael Hinczewski *Jul '14 - Present*

Questions:

- Is it possible to model the regulation of catch bonds under time varying force? - What physics principle can we learn from the model?

Progress:

- We have found such a model and physical principle behind it.
- In the process of writing a paper and submitting to a peer-reviewed journal.

Persistence Length of Virus

Supervisor: Prof. Michael Hinczewski *May '14 - Aug '14*

Plant based viruses can be used as drug vector of cancer medication. Our job was to figure out stiffness of different plant based viruses.

Questions:

- Given TEM images, is it possible to figure out persistence length of viruses?

Progress:

- We used ImageJ to collect extract end-to-end distance of viruses.
- By assuming viruses as worm-like chain polymer, we calculated the persistence length of viruses.

Conferences & Talks

Attended Ohio Section of the **APS meeting (2008 & 2009)**

Poster presentation at **Ohio Wesleyan University OSAPS meeting on "Conformation of Lennard Jones chain in explicit solvent: A solvation potential approach" (2010)**

Poster presentation at **Hiram College on "Conformation of Lennard Jones chain in explicit solvent: A solvation potential approach" (2009 & 2010)**

Talk on **"Computer Threats and Security Measures" as a Guest speaker at Hiram College (2010)**

Poster Presentation at **The Ohio Statehouse Atrium organized by The Ohio Foundation of Independent Colleges on "Conformation of a Polymer Chain in Solvent: Mapping a Many Body onto a Few Body Problem" (2011)**

Poster Presentation at **APS March Meeting "Conformation of Lennard Jones chain in explicit solvent: A solvation potential approach" (2011)**

Poster Presentation at **Single Molecule Biophysics Conference at Aspen Physics Center "Unraveling the Energetic Mechanism of the Cadherin-Catenin/Actin Catch bond" (2017)**

Poster Presentation at **Gordon Research Conference "Unraveling the Energetic Mechanism of the Cadherin-Catenin/Actin Catch bond" (2017)**

Courses

Mathematics: Calculus, Linear Algebra, Differential Equation, Statistics, Chaos Theory, Stochastic Processes
Physics: Classical Mechanics, Quantum Mechanics I & II, Electrodynamics, Statistical Mechanics, Magnetic Resonance Imaging, General Relativity
Computer Science: Compiler Design, Database Design, Computer Ethics, Introduction to Java
Coursera ***(Audited)***: Machine Learning by Andrew Ng, Deep Learning Specialization(Neural Networks and Deep Learning, Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization, Structuring Machine Learning Projects, Convolutional Neural Networks)
Edx: Quantum Mechanics and Quantum Computing *(BerkeleyX Completed)*

Students

Supervised in undergraduate research: Jacob Moran (CWRU), Marcus Lapeyrolerie(CalTech)
Mentored in high school project: Nicholas Kernan

Computer Skills

Languages: C, Python, Julia, LaTeX, PHP, SQL
Scientific Software: Maple, Kaliedagraph, Origin, Mathematica
Research Tools: Chimera, PyMol, High Performance Computing
Simulation Techniques: Monte Carlo, Brownian Dynamics, Kinetic Monte Carlo
Image Processing: Photoshop, InkScape, ImageJ, GIMP

Extra Interests

Hobbies: Photography, Rock climbing, Hiking