Bodhi P. Vani

Contact bvani@umd.edu **Citizenship** India

Education

University of Chicago
PhD in Chemistry, M.S. in Chemistry
2015-2021

Indian Institute of Technology, Bombay
M.Sc. in Chemistry, minor in Physics
2010-2015

Research Interests

I apply and develop machine learning techniques with enhanced sampling algorithms to systems of biological and medical significance. With my rigorous background in stochastic processes and statistical mechanics, as well as experience with biomolecules, and a growing repertoire of deep learning methods, I aim to use applied mathematics and computation molecular biophysics to improve human health through drug discovery. My current research focuses on solving the so-called separation of timescales with intelligently learned latent spaces.

Current Position

Post-Doctoral Scientist
Institute of Physical Science and Technology, University of Maryland, College Park

Research Experience

University of Maryland, College Park
Primary Investigator: Prof. Pratyush Tiwary 2021-current

• Developing a computational drug design pipeline based on machine learning algorithms and enhanced sampling methods
• Developing a graph attention network based model to predict ligandability in proteins
• Extending the use of structure prediction algorithms to obtain conformationally diverse structures and guide sampling to obtain relevant states with Boltzmann weights
• Exploring native state conformational changes and stabilities to identify druggable pockets for the kinase family of molecules
• Explaining and predicting optimal lengths of disordered regions in CAR T-Cell therapies using machine learning models
• Combining equivariant graph neural networks with variational autoencoders to learn bias collective variables without handpicked a priori information

University of Chicago
Advisors: Prof. Aaron R. Dinner, Prof. Jonathan Q. Weare 2016-2021

• Developed an algorithm to accelerate the computation of Feynman-Kac equations using trajectory stratification
• Derived methods to compute Transition path Theory quantities using trajectory stratification
• Studied the folding and unfolding mechanism of the Insulin dimer by deducing key collective variables and residues involved
• Developed a methodology to approach coupled folding-binding problems using a combination of sampling techniques with experimental collaboration

Indian Institute of Technology, Bombay: Master's thesis
Guide: Prof. B. L. Tembe 2014-2015

• Studied the local structures and potential energies of a pair of neopentane molecules in aqueous solutions of taurine, urea, urea-taurine in comparison with pure water using constrained dynamics

Tata Institute of Fundamental Research: Summer internship
Guide: Prof. Ravi Venkataramani Summer 2013
• Studied the aggregation of amino acids in water in collaboration with an experimental group using the transition path sampling algorithm

Indian Institute of Technology, Bombay: Summer Internship
Guide: Prof. Arindam Chowdhury May- July 2012
• Tracked and analyzed the fluorescence spectra of a dye in motion in a polymer layer medium.
• Resolved the single molecule spectra of the polar dye using computational image processing methods to derive the orientation of the molecules in polar coordinates and monitor rotational motion of the molecule in long time scales.

Indian Institute of Technology, Bombay: Summer Internship
Guide: Prof. Y. U. Sasidhar May- July 2011
• Studied the hairpin forming tendencies of a polymer by simulating several mutants and characterizing folding behavior.

Service & Outreach

Machine learning and pytorch training group
Organized and co-lead a weekly machine learning workshop for graduate students and post-doctoral fellows with a focus on AI for science - 2023

Peer reviewer for publications
Proteins: Structure, Function, and Bioinformatics - 2022
Physical Review Letters - 2023

Expanding your Horizons: Science outreach for highschool girls with aptitude in science
Supervised a group of 10 students through all their workshops - 2017
Developed and conducted a workshop on material properties - 2018

Computational Chemistry - University of Chicago Spring 2016
Conducted weekly help sessions, developed, graded, and edited assignments, provided support with final project

General Chemistry & General Chemistry Honors- UChicago Fall 2015, Winter 2016
Conducted weekly discussion sessions and lab sessions

Freshman Quantum Chemistry Course- IIT Bombay Fall 2014
Conducted weekly tutorials for a 45-student class
Single-handedly conducted regular help-sessions for a class of over 200

Conferences & Symposia

MolSSI workshop: Machine Learning and Chemistry: Are We There Yet?
May 31-June 2, 2023

Rare Events Workshop: Analysis, Numerics, and Applications
February 27-March 3, 2023

Protein Dynamics Gordon Research Conference
October 23rd-28th, 2022
Awarded prize for best poster

Protein Dynamics Gordon Research Symposium
October 21st-23rd, 2022

Physical Review Letters Journal Club: ***State-of-the-art estimation of protein model accuracy***
December 5, 2022
Invited to moderate panel discussion

Berkeley Statistical Mechanics Meeting
January 11th-14th, 2018

Midwest Theoretical Chemistry Conference
June 21st-23rd, 2018

8th CRSI-RSC joint Symposium in Chemistry
February 6th, 2014

16th CRSI National Symposium in Chemistry
February 7th-9th, 2014

14th CRSI-NCL Theoretical Chemistry Symposium
December 18th-21st, 2014

Publications

AlphaFold2-RAVE: From sequence to Boltzmann ensemble
Bodhi P. Vani, Akashnathan Aranganathan, Dedi Wang, Pratyush Tiwary. J. Chem. Theory Comput. 2023; https://doi.org/10.1021/acs.jctc.3c00290

Graph Attention Site Prediction (GASP): Identifying Ligandable Binding Sites with Graph Attention Networks
Zachary Smith, Bodhi P. Vani, Michael Strobel, Pratyush Tiwary *In preparation*

Hinging on Success: Leveraging the Power of CAR T-Cell Therapy through In-Silico Modeling of Hinge Length and Epitope Location
Justin M. Mirazee, Akashnathan Aranganathan, Bodhi P. Vani, Pratyush Tiwary, Gregoire Altan-Bonnet, Naomi Taylor *In preparation*

Computing transition path theory quantities with trajectory stratification
Bodhi P. Vani, Jonathan Weare, and Aaron R. Dinner. *Journal of Physical Chem.* 157, 034106 (2022)

Molecular dynamics simulations of nucleotide release from the circadian clock protein KaiC reveal atomic-resolution functional insights
Lu Hong, Bodhi P. Vani, Erik H. Thiede, Michael J. Rust, Aaron R. Dinner. *Proceedings of the National Academy of Sciences* Dec 2018, 115 (49)

Insulin Dissociates by Diverse Mechanisms of Coupled Unfolding and Unbinding
Adam Antoszewski, Chi-Jui Feng, Bodhi P. Vani, Erik H. Thiede, Lu Hong, Jonathan Weare, Andrei Tokmakoff, and Aaron R. Dinner. *The Journal of Physical Chemistry B* 2020

Long-timescale predictions from short-trajectory data: benchmark analysis of a miniprotein
John Strahan, Adam Antoszewski, Chatipat Lorpaiboon, Bodhi P. Vani, Jonathan Weare, Aaron R. Dinner. *Journal of Chemical Theory and Computation* 2021, 17, 5, 2948–2963

Accelerating computations of Large Deviation Functions using non-equilibrium stratification
Bodhi P. Vani, Jonathan Weare, and Aaron Dinner *in preparation*

Scholarships & Awards

The Danute Nitecki graduate fellowship - 2018
University of Chicago

Gordon Research Conference Best Poster
2022 Protein folding and dynamics conference

INSPIRE: Science fellowship 2010-2015
awarded by the Department of Science and Technology, Government of India

References

Prof. Pratyush Tiwary, Post-doctoral Advisor
University of Maryland, Institute of Physical Science and Technology
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Prof. Aaron R Dinner, Ph.D Advisor
University of Chicago, Department of Chemistry
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Prof. Jonathan Weare, Ph.D Co-advisor
Courant Institute of Mathematical Sciences, NYU
weare@cims.nyu.edu

Prof. Suriyanarayan Vaikuntanathan. Ph.D Committee member
University of Chicago, Department of Chemistry
svaikunt@uchicago.edu