

Vivin Vinod

PHD STUDENT/RESEARCH ASSOCIATE · COMPUTER SCIENCE

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Education

Jacobs University Bremen GmbH

Bremen, Germany

PHD COMPUTER SCIENCE

2022 - present

- *Supervisor:* Prof. Dr. Peter Zaspel
- *Grant:* Grant from the German Research Foundation (DFG) for simulation of Excitation Energy Transfer in a Photosynthetic System with more than 100 Million Atoms
- *Research:* Generating multi-fidelity machine learning models with varying levels of input data precision to overcome data expense and reduce simulation time

University of Pisa

Pisa, Italy

MS ECONOMICS

Sep' 2019 - Jul' 2021

- *Score:* 110/110
- *Course (brief):* Advanced statistics, Computational economics, Advanced econometric theory, Advanced microeconomic simulation, Financial Economics, Mathematical Methods for Finance, Small Area Methods for Analysis of Multidimensional Poverty Data (SAMPIEU Chair)
- *Thesis:* Credit Risk Modelling in Application: Catastrophe Swaps and Deep Learning Approaches
- *Advisor:* Dr. Davide Radi

St. Stephen's College, Delhi University

Delhi, India

BSc PHYSICS(HONS)

Jul' 2016 - Jul' 2019

- *CGPA:* 8.2/10.0
- *Minors:* Philosophy, Mathematics
- *Course (brief):* Lab R&D, quantum mechanics, statistical mechanics, electrodynamics, special relativity, advanced mathematical physics, solid state physics
- *Research:* Lennard Jones mono-atomic and diatomic gas simulation, chaotic systems and basin boundaries, Ising model simulation with Metropolis Hastings algorithm and Wolf Cluster algorithm (extended to social dynamics of voter models), Non-relativistic star cluster simulation with collision, Helium atom eigen states using Genetic algorithms, time evolution of plucked string and struck sheet, chaos as secure channel for communication using Chua's circuit

Certificate Courses

Web based

ACADEMIC DEVELOPMENT

2016-present

- IBM Data Science Course - 96.4% - November 13, 2019 2:04 PM GMT
- Astrobiology capsule course - Grade A - conducted by United Nations & Indian Astrobiological Research Centre (2016)

Professional Experience

Feb'22-
present

Research Associate, Jacobs University Bremen, Germany

Working under DFG grant for simulation of 150 million atoms. Aimed generate multi-fidelity machine learning models in multi-dimensions for quantum chemistry and molecular biophysics under Prof. Dr. Peter Zaspel employing interdisciplinary methods for package development.

Jan'21- **Junior Research Intern**, National Institute of Statistics, Italy (ISTAT)
Jun'21

Evaluated orthophotos into a readable format as part of pre-processing metric for subsequent data manipulation. Developed U-NET DL hybrid to produce masks of orthophoto segmentation. Analyzed output in a reproducible manner. Implemented 12 channel satellite image segmentation model for integration with ISTAT policy making sector.

2021 **Graduate Teaching Assistant**, Dept. of Economics, University of Pisa
TA for mathematical methods for economics.

2016-2021 **Volunteer Tutor**, India Mission, India
Educator and facilitator to high school students in mathematics and natural sciences.

Publications

PUBLISHED

V. Vinod 2021. Credit Risk Modelling in Application: Catastrophe Swaps and Deep Learning Approaches. UNIPB Biblio.

V. Vinod 2020. Data laws and ethics of machine learning. UNIPB (2021).

V. Vinod 2020. Economic Indicators of Poverty policy paper for poverty analysis in EU and Italy using multidimensional panel data. UNIPB & Jean Monnet Chair (2021).

V. Vinod. 2021. U-NET DL Hybrid model for orthophoto segmentation. ISTAT Research Reports.

IN REVIEW

V. Vinod and D. Radi. 2021. Credit Risk modelling using Self-Organizing-Maps. UNIPB (2021).

IN PREP

D. Salgado, M. Necula, B. Oancea, S. Barragan, and V. Vinod. 2021. Delauney triangulation for Voronoi partition: n-neighbour assessment of closest antenna fallacy.

Awards, Fellowships, & Grants

Jul'21 **SAMPIEU Award**, Jean Monnet Chair €1,000

Dec'19 **International Student Award**, University of Pisa €1,350

Feb'18 **Meera Memorial Award**, St. Stephen's College, DU ₹3,000

Jul'17 **College Bursary Grant**, St. Stephen's College, DU ₹20,000

Presentations

* *presenting author*; + *collaborative*

INVITED TALKS

Nov 2021. *Delauney Triangulation for Voronoi Partition for implementation in Simulated Mobile Network Data*. Invited talk: International Conference Use of R in Official Statistics (uRosConf 2021), Bucharest, Romania (Virtual).

Jul 2021. *Living conditions and Poverty in Italy - 2017. Small Area estimation and machine learning methods*. competitive participant (Winner), Erasmus+ & Centro Camilo Dagum & Jean Monnet Chair EU, Pisa, Italy.

Feb 2018. *Chua diode circuit as a secure communication device using chaos theory*. Invited talk: Meera Memorial Paper Presentation, Delhi, India.

CONTRIBUTED PRESENTATIONS

D. Salgado**, M. Necula⁺ and B. Oancea⁺, S. Barragan⁺, and V. Vinod⁺. 2021. *simviz: a package to visualize simulated telecommunication mobile network event data*. uROS Conference 2021, Bucharest, Romania (Virtual).

V. Vinod** and Y. Funk⁺. 2021. *Small area estimation methods for NUTS3 level poverty estimation in Italy*. University of Pisa and Scuola S'ant Anna, Pisa, Italy.

Teaching Experience

Winter 2021 **Mathematical methods for economics**, Teaching Assistant

*University of
Pisa, Italy*

Research Experience

INSTITUTIONAL RESEARCH

Jacobs University Bremen - Dept of Computer Science

Bremen, Germany

SUPERVISOR: PROF. DR. P. ZASPEL

Feb'22 - Present

- Highly interdisciplinary field of machine learning for quantum chemistry and molecular biophysics.
- Replace time and computationally expensive calculation of quantum chemistry calculations with generalised and scalable Multi-Fidelity machine learning (MFML) models.
- Simulate 150 million atom Bacterio-Chlorophyll (BChl) Light Harvesting complex (LHC) by focusing on excitonic energy transfer in the organelle.
- Employ cheap classical molecular dynamics to provide detailed quantum mechanical description of LHCs.
- Reduce amount of expensive data required to train model for excitonic energy prediction.
- Develop MFML models with consistent average accuracy at least equivalent to DFT methods.
- Train MFML model with augmentation to accommodate environments of large complex in a flat membrane and subsequently a full scale chromatophore complex.

INE Spain - Dept of methodology for OS & INS Romania - Dept Innovative tools in OS

Tucson, AZ

CO-ADVISORS: DR. D. SALGADO & DR. M. NECULA & DR. B. OANCEA & DR. S. BARRAGAN

Sep'21-Jan'22

- Voronoi partition analysis for simulated network big data analysis for use in official statistics (OS).
- Develop visualisation packages for **simviz** package in R to be integrated into big data analysis of ground truth network data.
- Voronoi neighbourhood assessment to study nearest antenna connection fallacy in mobile network data analysis. Results show benefit of **simviz** over conventional methods of analysis.

University of Pisa & Scuola S'ant Anna Pisa - Dept of Economics & Management

Pisa, Italy

ADVISOR: DR. D. RADI

Jan'21-Jul'21

- Thesis: "Credit Risk Modelling in Application: Catastrophe Swaps and Deep Learning Approaches".
- Self organizing maps applied to hands-on approach for study of credit risk defaulting to banks.
- Compound Poisson process modelling of Catastrophe swaps with both ex-ante and loss re-estimation pricing.
- Using U-NET CNN and hybrid deep learning to estimate catastrophe swap prices during loss re-estimation.

National Institute of Statistics - Department of Statistical Production

Rome, Italy

CO-ADVISORS: DR. C. GUISTI & DR. A. FERRUZZA & DR. L. CONSTANZO & DR. S. MUGNOLI

Jan'21-Jun'21

- Projects: Satellite image segmentation to study urbanisation and generate higher level metrics of poverty for policy making.
- Deployed deep U-NET convolutional neural network (CNN) model in interest of 5-fold image segmentation of 12-channel satellite image input.
- Data cleaning and analysis from noisy satellite channels by incorporating multi-channel inputs.
- Test ANN models to predict urbanization as a function of different input variables including foliage cover, buildings, roads, and crop cover change.
- Proposed work on converting .ecw files to python readable formats to assist future development of this branch of work.

MISCELLANEOUS AND SINGULAR RESEARCH

Computational Physics

Python, MATLAB

SELF

2016-2019

- Basin boundary analysis of chaotic map generated from simulated population dynamics. Study of the chaotic driver driven pendulum with n-pendulum estimate simulation of suspended rope/chain.
- MATLAB simulation of Chua's diode
- Ideal Lennard-Jones fluid simulation on toroidal topology to study barometric & thermodynamical properties and confirm time reversal symmetry. Circular boundary topology was studied separately to confirm loss of time reversal symmetry.
- Simulation of Bose-Einstein condensation in Harmonic Traps
- Time dependent Schrödinger equation evolution for single particle in generalised time independent potentials using Eigen states and separately using Numerov algorithm for time independent Hamiltonian.
- Monte Carlo simulation of ferromagnetism in material domains to study thermodynamic effects.
- Study of critical points and their evolution over time for multiple systems including Romeo & Juliet, asynchronous pendulums (Steven Strogatz, *et al*), and The Butterfly Effect.
- Three body gravity simulation with general relativity correction term.

Machine Learning

TensorFlow, PyTorch, Keras,

Scikit

ANDREW NG & IBM & GOOGLE DEVELOPERS

2017-2019

- ARMA and VAR models to predict stock prices for 40 day horizon. Employed LSTM architecture to forecast stocks with standard deviation of 0.3% on 40 day horizon.
- Designed and implemented ANN model to solve customer churn problem. Estimated the probability of a customer exiting the company. Streamlined code for generalized use. Optimized the model hyperparameters with Bayesian tuning with scikit and random forest algorithm.
- Spam e-mail filtering
- Auto-encoders and Boltzmann Machines for suggestion and prediction
- Handwriting recognition using PyTorch