Curriculum Vitae

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Education

2020–Current	PhD in Physics, LIPh Lab, Department of Physics, University of Padua
2015–2020	Integrated BS-MS at Indian Institute of Science Education and Research, Kolkata

PhD

Sep 2020 - Current	**PhD in Physics** Dr. Amos Maritan and Dr. Sandro Azaele — University of Padua

Traditionally, ecosystems and ecology have been the forte of biologists. But with tools of mathematical modelling, it is possible to predict the evolution of ecosystems and populations. This works because ecosystems are comprised of large number of individuals whose interactions and behaviour can be looked at through a zoomed out perspective. One option is to model these as ordinary differential equations, like the Lotka Volterra prey predator model. This is equivalent to a mean field approach in statistical mechanics. Another way is to model ecosystems using Stochastic Differential Equations which allow us to capture the fluctuations and effect of noise present in these systems. These tools from non equilibrium statistical mechanics can then be applied to various questions. One such question is how do ecosystems respond to perturbations and fluctuations. We aim to explore this question using tools like Fokker Planck Equation and Linear Response Theory. Our goal is to understand the theoretical framework behind how such systems will respond to change in parameters and how we can use this knowledge and apply it to specific ecosystem models to gain a better understanding of the properties of these ecosystems.

Conferences and Workshops

December 2020	**Winter School on Quantitative Systems Biology — (Online) Trieste, Italy** Organized by ICTP Trieste
September 2019	**Introduction to High Performance Computing — Kolkata, India** Organized by IISER Kolkata, India
July 2019	**Conference on Complex Systems - 2019 — Trento, Italy** Organized by Complex Systems Society, Italy
June 2016	**Physics of Life, Annual Monsoon School — Bangalore, India** Organized by Simons Centre for the Study of Living Machines, NCBS

Earlier Experience

August 2019 - 2020	**Masters Thesis - Collective Dynamics : Long range order of SPPs in heterogenous media** Dr. Rumi De — IISER Kolkata Collective ordered motion (flocking in common terms) is seen in nature frequently. Efforts to explain this through simple rules has been an ongoing endeavour for the past few decades. Simple models with Self Propelled Particles (SPPs) have been found which result in flocking and also show phase transitions like physical systems. Taking these models a step further, we introduced heterogenity in the medium through placement of obstacles. The motivation comes from analogy of a herd of deer encountering a tree or a school of fish encountering a rock. We tried to understand how obstacles affect the dynamics of the system and what specific properties (geometry, area, number etc) of obstacles are more important than others.
Fall 2019	**Non-linear Workbook in Python** Dr. Ananda Dasgupta — IISER Kolkata The book The Nonlinear Workbook by Willi Hans Steeb is a toolbox of various algorithms and methods used in the field of non-linear dynamics. The book contains the tools and brief overview of the math behind the tools, ranging from chaos to genetic algorithms to neural networks. The goal of the independent study was to study the algorithms and tools listed in the book and to recreate them in Python (using plain python and at places possible, the available additional packages).
Summer 2019	**Stochastic Amplification of Ecological Systems** Dr. Amos Maritan — University of Padua, Italy Population Level Models often show different behaviour than Individual Level Models because the PLMs are mean field equivalent of the ILMs. In particular, Lotka Volterra equations in finite size systems do not show cyclic populations (unlike infinite population size model). But in observation, we see many predator prey systems having cycles. This can be explained using tools of stochastic processes (like Fokker Planck Equation, van Kampen Expansion, Langevin Dynamics) which manage to include the finite size effects and stochasticity in the population to qualitatively show cycles in population with finite size. The same tools were also extended to MacArthur Consumer Resource model to show non trivial power spectrum of simulated time series population data.

Teaching Assistant-ship

Spring 2020	**Research Methodology** Brief overview of history and philosophy of science and includes hypothesis testing, model formulation, ethics in science and other such topics.
Fall 2019	**Computational Physics** Exposure to techniques for solving differential equations, matrix equations and simulation of non equilibrium processes.

Extracurricular Activities

Web Development	**Designed websites for the following:** Inquivesta : Annual College Fest of IISER Kolkata Lexis : Literary Festival of IISER Kolkata Campus Radio : College Radio Station IICM : Inter IISER Cultural Meet iGEM IISER Kolkata : International synthetic biology competition started by MIT
Dramatics	**Encounters with theatre include:** Dramatics Club Treasurer in year 2017 Cast member in multiple college plays
Initiatives	**Helped start/lead the following events at IISER Kolkata:** iGEM : Helped start iGEM team which bagged gold at Boston twice Lexis : Started the first literary fest at the college Inquivesta : Lead the fest as events coordinator in 2017 Campus Radio : Started and served as Chief Operations Officer at college radio station