Probabilistic modelling and simulation of reacting systems

Programa Institucional de Bolsas de Iniciação Científica

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1 Position

Description

Stochasticity is a fundamental aspect of (bio-)chemical reacting systems. In some situations the system can be understood as a large number of molecules interacting in a homogeneous environment, and so the dynamics are well-captured by deterministic ordinary differential equations. In many other situations, the system can be driven by a small number of molecules or it can be strongly influenced by a fluctuating environment. Models must allow molecules to change and interact in complex ways. Stochasticity increases the complexity of models in some ways, but may also simplify and smooth results in other ways. This project work aims at studying the stochastic modelling and simulation of chemical reaction networks ([1]).

The mathematical focus is on counting processes and continuous-time Markov processes. The computational focus is on exact and approximate stochastic simulation tools. Applications to bio-chemical networks in environmental systems biology motivate the study. While the research of the project shall be understandable to students who have had an introductory-level exposure to probability theory, statistical inference and differential equations, the most suitable profile is the student who have also studied stochastic processes in continuous time.

If you are interested, get in contact: FRANCESCO.CORONA@UFC.BR

References

[1] Anderson DF and Kurtz T. 2015. *Stochastic analysis of biochemical systems*. Springer.