

Young Researcher position

Field: quantitative modelling and simulation of metabolic networks

Mentor: prof. dr. Miha Mraz

Description

New scientific disciplines that aim to understand the dynamics of biological systems as a whole have emerged in last two decades, namely systems and synthetic -biology, and systems and personalized medicine. These disciplines apply similar techniques to increase the understanding of cellular processes, which can be decomposed in three different networks governing the dynamics of a cell, ie. gene regulatory networks, metabolic networks and signal transduction networks. Integrating these networks into a comprehensive whole-cell model would allow us to fill the gaps in the understanding of cellular dynamics and to use this knowledge in different applications, such as production of biofuels, biologicals and treatment of complex diseases. In the past, new discoveries were mainly based on the laborious experimental work. Recently, this has been at least partially substituted with the computational modelling and simulation approaches. These can be used to reject or confirm the hypotheses before experimental work is performed and thus to drastically reduce the amount of expensive experiments.

Computational modelling and simulation of biological system is based on the methods of computational biology. These methods can be divided among qualitative and quantitative, and deterministic and stochastic. The goal of qualitative methods is the identification of qualitative relations among the biological entities, such as proteins. The goal of quantitative methods is the establishment of mathematical models, that can be used to simulate the dynamics of biological entities and thus to obtain biologically relevant numerical data. The work of the young researcher will be mainly focused to the methods for quantitative modelling of gene regulatory and metabolic networks.

The young researcher will work in the research group that has an excellent publication record in the fields of quantitative modelling and simulation of metabolic networks with an emphasis on the liver metabolic networks, quantitative modelling and simulation of the influences of circadian rhythm on the dynamics of mammalian cells, modelling and simulation approaches that can be used when the kinetic parameters governing the dynamics of observed biological processes are unknown, and on the field of the visualization and analysis of cellular networks.

The group has been applying, upgrading and developing different methodologies that a based on ordinary and partial differential equation, flux balance analysis (FBA) derived methods and statistical analyses of experimentally obtained data.

Useful additional skills / training:

- good knowledge of English language;
- enthusiasm for work on interdisciplinary research field of biological systems modelling and analysis;

- basic programming skills (Python, Matlab).

The web page of the Computational Biology Group which will train the young researcher is available at <http://lrss.fri.uni-lj.si/bio/>