Master's thesis project in computational systems biology/scientific computing:
Investigation of the accuracy in mesoscopic simulations of reaction-diffusion processes on unstructured meshes.

Systems biology is relatively new field in computational biology. It combines knowledge and techniques from fields such as cell and molecular biology, applied mathematics and control theory and is as such inherently interdisciplinary. A question of great interest in systems biology is the impact of stochastic noise in models of e.g. gene regulation. Stochastic models offer an advantage over simple deterministic models, but unfortunately, for different reasons, they are more difficult to study computationally.

Up until recently, most stochastic models have treated the cell as a well stirred system, and in such way failed to capture spatial effects. In the computational systems biology group at the division of scientific computing (TDB) at Uppsala University we have developed methods and software to simulate stochastic reaction-diffusion models of biochemical networks on unstructured meshes. Unstructured meshes are a more flexible choice compared to Cartesian meshes, but they are harder to generate with good quality. How the quality and the structure of the mesh affect the simulation accuracy have not been well studied.

We are looking for a highly motivated student to investigate the effects of mesh quality and mesh resolution on the results of the stochastic simulations. One important part of the project will be to formulate relevant test cases and implement those tests in the existing software.

Candidates are expected to have knowledge of probability theory, basic statistics, and experience of programming in C/C++ and MATLAB. Proven interest in scientific computing and molecular cell biology is also considered a merit but is not a strong requirement.

Office space and computing equipment will be provided at TDB, Uppsala.

Candidates should contact Andreas Hellander (andreas.hellander@it.uu.se) (TDB, Uppsala) for more information. Interested candidates will be asked to submit a full curriculum vitae including a list of completed courses and grades along with a formal statement of interest (in the format of a letter).

Advisors of the project are Andreas Hellander (Uppsala) and Stefan Engblom (steng@csc.kth.se) at the department of computer science and communications (CSC) at the Royal Institute of Technology (KTH), Stockholm.