Possible topics for a bachelor thesis

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My main interests lie in numerical analysis (primarily numerical algorithms for hyperbolic partial differential equations), scientific and high performance computing (primarily parallelization, supercomputers, and GPU computing), and modeling (primarily plasma physics problems, fluid flow, and industrial applications). If you are interested in writing a bachelor thesis please contact me early enough either by E-mail (lukas.einkemmer@uibk.ac.at) or in person. We can then discuss possible topics in more details. Usually some implementation work will be required as part of the bachelor thesis (either in Python or C++). Having successfully completed the two numerical analysis courses in the Bachelor program is a prerequisite. The scientific computing elective course is also very useful for many of the topics. The bachelor thesis can be written in either English (preferred) or German.

Possible topics

- Prepare a collection of example programs that illustrate the solution of different partial differential equation and what boundary/initial conditions are appropriate for different applications.
- Global optimization algorithms (such as genetic evolution) and their use in applications.
- Modeling and simulation for anisotropic diffusion in cosmic rays.
- Extend a numerical simulation code and conduct plasma physics simulations (requires some experience with C++).
- Numerical solution and appropriate methods for the simulation of supersonic potential flow.
- Mesh free computation using radial basis functions.
- What information does the Fourier transform give if only a subset of the signal is known (Nyquist limit, windowed Fourier transform, aliasing, etc.).

In addition, here is a (selected) list of bachelor thesis topics that have been worked on in the past

- Simulation of the equilibrium distribution in a fusion rector.
- Simulating potential fluid flow around airfoils.
- The alternating direction implicit numerical scheme for solving the heat equation.
- Adaptivity in numerical methods (i.e. how can a numerical algorithm automatically choose an appropriate time step size or grid spacing).

- The multi-body problem and how to numerically solve it on a computer.
- Kalman filter and their application to sensor fusion.