Project: Efficient numerical solution of temporal multi-scale problems

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Background:

In the dynamic behaviour of many technical systems one can identify several temporal scales. For example, when describing the material damage and fatigue behaviour of wind turbines, there is a fast timescale describing rapidly oscillating rotor blades, a moderate timescale describing seasonal changes in wind loads and a long timescale of years for the damage parameter. Another example is the electromagnetic heating of metals, where temperature changes are of timescale 1 s whereas the electromagnetic field changes with order 10^-5 s. For the numerical solution of this kind of problems a time discretization respecting only the small time scale is prohibitive, instead all kinds of averaging techniques are considered.

Problem:

The goal of this project is to develop a homogenization approach for the efficient numerical solution of two spatially one-dimensional parabolic equations modelling induction heating of metals.
To this end a macroscopic homogenized heat equation will be derived with a heat source, which is averaged from a local in time 'cell problem' and implemented using finite differences.

Prerequisites:

- Basic knowledge about finite difference methods for ordinary differential equations
- Basic knowledge about solving linear systems in matlab

Training:

- Derivation of homogenized models, finite difference approximation of parabolic equations

Timeframe:

- 50-100 h work