TU Clausthal

Cloud performance analysis and COMPARISON of four software solvers for the LLG equation (MAgpar, NMAG, OOMMF and Vampire)

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Nowadays Solid-State-Drives are used in computers to store and retrieve digital information. They employ the spin-transfer torque (STT) technology, which is based on magnetic properties of micromagnetic materials. Therefore, it needs to model these materials for miniaturization in magnetic sensor technology, increasing the information density in magnetic recording and the improved availability of large-scale computer power. It is known that the micromagnetics' materials are modelled by the Maxwell equations and by the so-called Landau-Lifschitz-Gilbert equation (LLGE).

Modeling of LLG equations requires high computational processing which can be done by providing a platform for parallel processing and subdividing the LLGE models into smaller, simpler parts using two methods of micromagnetic modeling: finite difference (FD) and finite element (FE) method. Message passing interface (MPI) is one of the technologies, which is supporting parallel processing. Additionally, modern Cloud technology can be used in parallel processing and computing systems by providing a suitable performance in parallel calculation and simulation.

The purpose of this work is to find some suitable software solvers, which are MPI-based and use the LLG equation to solve and model micromagnetic problems. In the following, some of the LLG equation problems are prepared and modelled, which include the energy contributions of the anisotropy, exchange interaction and the magnetostatic interaction. Furthermore, the parallel processing and computing by micromagnetic solvers will be checked with the help of MPI in OpenStack Cloud environment and a final software performance evaluation will be presented.

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