uses the message-passing paradigm to implement the PCG method with geometric multigrid as a preconditioner.

For the mesh adaptation, the 8-tetrahedra longest-edge partition is used as a refinement mesh algorithm. In this paper, a new method for parallelizing this algorithm is presented, based on the Longest-Edge Propagation Path approach. The method was developed for the message-passing model, and implemented using the MPI standard. The new solution is based on a decentralized approach. So it is more scalable in comparison to previous implementations, where a centralized synchronizing node (coordinator processor or gateway node) is required.

Both the sequential and parallel versions of the mesh adaptation are carefully optimized to maximize performance. One of key solutions is the usage of suitable data structures, such as hash tables. They allow for high performance while preserving modest memory requirements. The last criteria is especially important for large FEM problems, most interesting from the point of view of using FEM analysis in modern engineering practice.

Transport Modeling in Spin Field-Effect Transistors Built on Silicon Fins

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The spin field-effect transistor (spinFET) proposed by Datta and Das is composed of ferromagnetic metallic source and drain contacts which sandwich a semiconductor region. Silicon is the main element in microelectronics and it will play a significant role in future spintronic devices because of a long spin life time due to the small spin-orbit interaction and the absence of nuclei with non-zero spin. However, the weak strength of the spin-orbit interaction presents an obstacle for the use of silicon in a spinFET. Interestingly, (001) confined silicon structures show a relatively large electric field dependent contribution to the spin-orbit interaction. This interaction is due to the interface-induced inversion asymmetry and is of a Dresselhaus form. The stronger spin-orbit interaction does not lead to increased spin decoherence in quasi-one-dimensional structures, where it is suppressed.

We calculate the transport properties of spinFETs with silicon fins in [100] and [110] directions. We obtain the dependences of the transmission probabilities for spin up ($\uparrow$) or down ($\downarrow$) $T_{\uparrow(\downarrow)}^{P(AP)}$ on the strength of the spin-orbit interaction in the parallel (P) and antiparallel (AP) configuration of the ferromagnetic contact magnetization. To solve the system of equations obtained from the boundary conditions we use a matrix method, which is the fastest way to find the transmission and reflection coefficients. The dependence of the conductances $G^{P(AP)} = e^2(T_{\uparrow}^{P(AP)} + T_{\downarrow}^{P(AP)})/(2\hbar)$ and tunnel magnetoresistance defined as $TMR = (G^P - G^{AP})/G^{AP}$ on the fin orientation, spin-orbit interaction, magnetic field, and the conduction band missmatch between the channel and electrodes are computed.