Abstract of the Thesis

Anwendung diskreter raumfüllender Kurven

Graphpartitionierung und Kontaktsuche in der Finite-Elemente-Simulation

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Application of Discrete Space-Filling Curves

Graph Partitioning and Contact Search in Finite Element Simulations

In this thesis we evaluate the application of space-filling curves in the areas of graph partitioning and contact search within the finite element simulation. The graph partitioning is an important task for the efficient parallelization of numerical applications. The computational load has to be distributed evenly on the parallel processors and the communication cost has to be minimized. Contact search is a crucial task during the simulation of moving and deforming bodies. In many applications it is one of the most time consuming phases of the whole calculation. This thesis shows the applicability of space-filling curves in both fields in analytical and experimental evaluations and within an industrial application.

The quality of partitions induced by space-filling curves depends on the structure of the graph. For regular grids we show that the quality is provably good. It is less than 84 % worse to optimum in worst case analysis. A comparison to the graph partitioning heuristic Metis shows satisfying results for most of the evaluated unstructured meshes.

For the contact search based on the position-code method we propose an indexing based on space-filling curves. We show that this extension leads to a significantly reduced algorithmic complexity within a realistic scenario. We define a new metrics on the locality preserving properties to allow a comparison of different space-filling curves for this purpose. It is shown that the $\beta\Omega$-indexing, which is introduced in this thesis, is best suited for the examined task.