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GPU vs CPU - Comparative Performance Evaluation of Parallel Linear Solvers for TCAD

Will typical technology computer aided design (TCAD) applications in electronics benefit from GPUs? This talk sheds some light on the domain-specific challenges in TCAD and presents results on using GPUs for a range of representative TCAD examples. Performance results will be presented for two common machine configurations: Single workstations on the one hand, and small clusters, as they are typical for in-house simulations, on the other hand. Our results allow for better decisions on when additional development time for GPU acceleration may be well spent.

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Recent Advances in High Performance Process TCAD

Process technology computer-aided design (TCAD) deals with simulating semiconductor device fabrication steps, such as etching and deposition, to enable computer-based device designs. The simulation backends are based on a variety of numerical methods, e.g., particle transport, surface advection, diffusion, and stress calculation, underlining the inter-disciplinary nature of this topic. The rapidly evolving device concepts in electronics more and more utilize the third dimension - in contrast to previous planar technologies - to sustain the demand for higher integration densities: More compute performance or storage capacity is required whilst simultaneously limiting power consumption and if possible reducing device sizes. Future device designs will continue on this three-dimensional (3D) design path which will further increase the already dire need for fast and accurate 3D simulation capabilities to fully capture 3D effects arising during the individual fabrication steps. In this talk, recent advances in high performance process TCAD will be presented. The focus will be on accelerated flux calculation approaches and re-distancing algorithms: both important for a wide range of processing steps but also potentially relevant to other application areas. *The financial support by the Austrian Federal Ministry for Digital and Economic Affairs and the National Foundation for Research, Technology and Development is gratefully acknowledged.*

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MS54

LAP A Fast Solver for Coupled Imaging Problems

Coupled nonlinear inverse problems arise in numerous imaging applications, and solving them is often difficult due to ill-posedness and high computational cost. In this work, we introduce LAP, a linearize and project method for coupled nonlinear inverse problems with two (or more) sets of coupled variables. LAP is implemented within a Gauss–Newton framework. At each iteration of the Gauss–Newton optimization, LAP linearizes the residual around the current iterate, eliminates one block of variables via a projection, and solves the resulting reduced dimensional problem for the Gauss–Newton step. The method is best suited for problems where the subproblem associated with one set of variables is comparatively well-posed or easy to solve. LAP supports iterative, direct, and hybrid regularization and supports element-wise bound constraints on all the blocks of variables. This offers various options for incorporating prior knowledge of a desired solution. We demonstrate the advantages of these characteristics with several numerical experiments. We test LAP for two and three dimensional problems in super-resolution and MRI motion correction, two separable nonlinear least-squares problems that are linear in one block of variables and nonlinear in the other. We also use LAP for image registration subject to local rigidity constraints, a problem that is nonlinear in all sets of variables. These two classes of problems demonstrate the utility and flexibility of the LAP method.

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Title Not Available

Abstract not available.

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Efficient Marginalization-based MCMC Approaches for Hierarchical Bayesian Inverse Problems

Hierarchical models in Bayesian inverse problems are characterized by an assumed prior probability distribution for the unknown state and measurement error precision, and hyper-priors for the prior parameters. Combining these probability models using Bayes' law often yields a posterior distribution that cannot be sampled from directly, even for a linear model with Gaussian measurement error and Gaussian prior. Gibbs sampling can be used to sample from the posterior, but problems arise when the dimension of the state is large. This is because the requisite Gaussian sample required for each iteration can be prohibitively expensive to compute and because the statistical