A Multi-Purpose Optimization Framework for TCAD Applications

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We present the multi-purpose simulation and optimization framework SIESTA that provides statistical analysis, design of experiments, and optimizations on TCAD-related problems with an easy-to-use and open application interface as well as a sophisticated load balancing system for performant distributed computing in heterogeneous networks.

In general, TCAD simulation software is available for a wide range of applications in the field of stationary and transient process and device modelling. The physics of semiconductor processes and devices is modeled with nonlinear coupled partial differential equations (PDEs) within the simulation software. In addition, modeling material parameters become highly complex for semiconductor devices operating on dramatically shrinked geometries. Hence, the model behavior may switch during different operation conditions.

Therefore, we have to apply highly flexible algorithms which are capable of handling a great variety of optimization goals. The specification for the optimization runs and the simulator for parameter evaluation is treated in a black box approach that enables a description independ on any knowledge about the dynamic relations of the simulation models used inside the evaluation software. In addition to the optimizers, a convergence checker is applied to ensure valid and performant convergence within certain constraints.

This environment offers also the opportunity to apply a parameterized external simulation tool flow which can include several dependent and independent simulation steps where each of these steps uses its own configurational setup. The independent evaluation steps are automatically performed concurrently.

Together with a sophisticated tailor-made load balancing system, SIESTA is able to schedule simulation tasks to a heterogeneous network as well as to other load sharing and balancing systems.

These features provide us the possibility to deal with a wide range of different problem classes to achieve sufficiently accurate optimization results within reasonable time.

In addition, we present several some example to illustrate the capabilities of our simulation and optimization framework.