Mesh Healing for TCAD Simulations

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Device geometries in technology computer-aided design (TCAD) processes are often generated using computer-aided design (CAD) tools, like the free open source package FreeCAD. However, geometries generated with CAD tools tend to lack geometric properties which are required for volumetric mesh generation. For example, the geometries may not be *watertight*. Additionally, geometries and meshes with multiple regions are often used to identify local properties, like materials. Geometries for such meshes may not fulfill topological criteria required for mesh conformity at the region interfaces, because many CAD tools export each region separately without taking account neighboring regions.
Popular discretization methods, like the finite element method or the finite volume method, fail, when using meshes which do not satisfy these topological criteria. Therefore, a *healing* process of the geometry is required, which identifies the errors and repairs them. Most available free open source meshing tools for mesh healing lack the ability to handle multiple regions, because of their origin in the field of computer graphics.
We address this problem by identifying and investigating common errors in device geometries generated by CAD tools. Algorithms, which detect and classify these errors, are presented and discussed. We show, that topological healing operations for device geometries with linear surfaces are often sufficient, which is not the case for geometries with non-linear surfaces. To achieve a stable healing process with a minimum of user interaction, we investigated surface reconstruction algorithms. We focus on the multiple material marching cubes algorithm due to its ability to handle multiple regions. This algorithm is applied to complex device geometries with non-linear surfaces, like a FlexFET device, generated via FreeCAD.
All presented algorithms have been implemented in the free open source meshing package ViennaMesh. A workflow, starting with the geometric modeling in FreeCAD, healing the geometry and generating a mesh is presented. With ViennaMesh's flexible module framework a reusable mesh healing and mesh generation pipeline can be set up. Using this pipeline a mesh can conveniently be created for TCAD simulations.

Is Nature a Monte Carlo Algorithm?

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In this talk we introduce a novel formulation of quantum mechanics based on signed particles, which comes from a physical interpretation of the Wigner Monte Carlo method in the light of recent experiments in the field of quantum tomography. In particular, we show that this new formulation not only can make the same predictions made by other more standard approaches, but has several important advantages such