A magnetostatic Boundary Element Method (BEM) solver for the General Particle Tracer (GPT) code

S.B. van der Geer, M.J. de Loos
Pulsar Physics, Eindhoven, The Netherlands
info@pulsar.nl

The General Particle Tracer (GPT) code is a well-established simulation package for the design of electron and ion optics. Key features of the code are 3D positioning of all beamline components, its ability to handle relativistic effects, and various particle-particle interaction models. Electrostatic fields in complex 3D geometries can be solved using a built-in hierarchical Boundary Element Method (BEM) solver. This dense matrix method does not require a volume mesh, is insensitive to scale differences, and it can produce analytical multipole expansions of the resulting fields. Presented is an extension to the BEM solver allowing non-saturated magnetostatic cases to be simulated in full 3D.

The new GPT extension affects five individual components of the code:

- The parametric 3D modeller can now also model arbitrarily shaped coils.
- The re-mesher (Figure 1) can take into account nearby coils.
- The hierarchical BEM solver can solve for magnetostatic scalar potential.
- Analytical on-axis multipole components include external coil excitations.
- On-axis, off-axis and chromatic aberration coefficients can be calculated for electrostatic, magnetostatic or combined tracking results.

Combined with the built-in capabilities of the GPT code, the above five components can work together to track particles through the most demanding electrostatic fields such as and aperture lens arrays and tip-geometries (figure 2). The new extension allows for 3D magnetostatic problems (Figure 3) where aberration coefficients for individual apertures can be obtained to 7^{th} order precision.

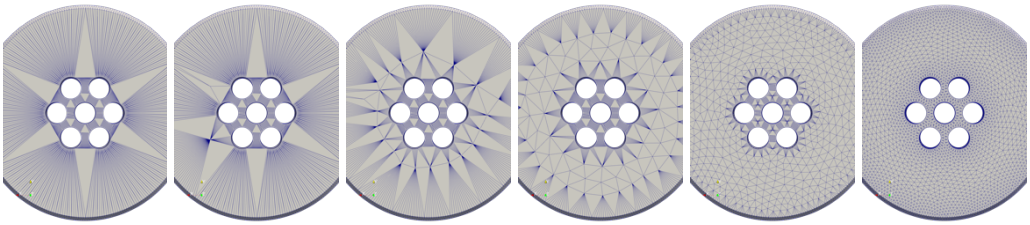

Figure 1: Illustration of the iterative re-meshing component converting a visualisation mesh into a computational mesh.

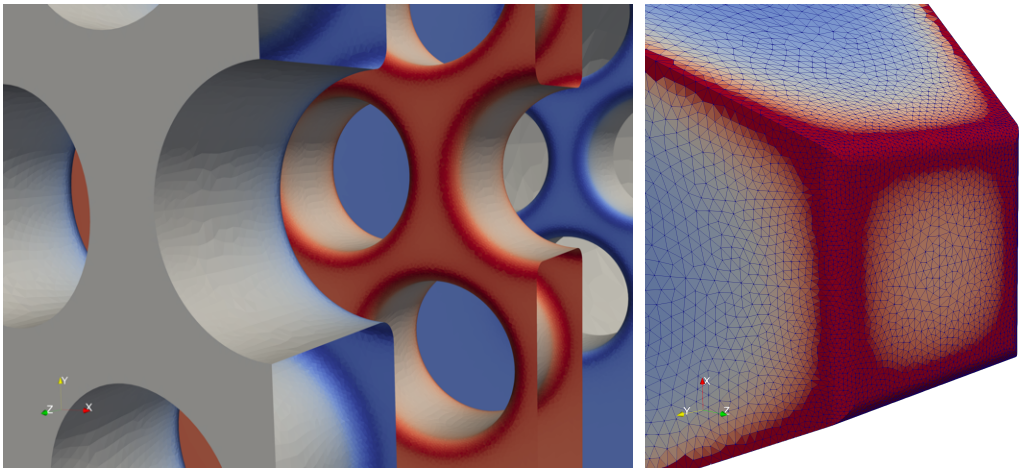

Figure 2: Surface charge density in an Einzel lens array and tip-geometry

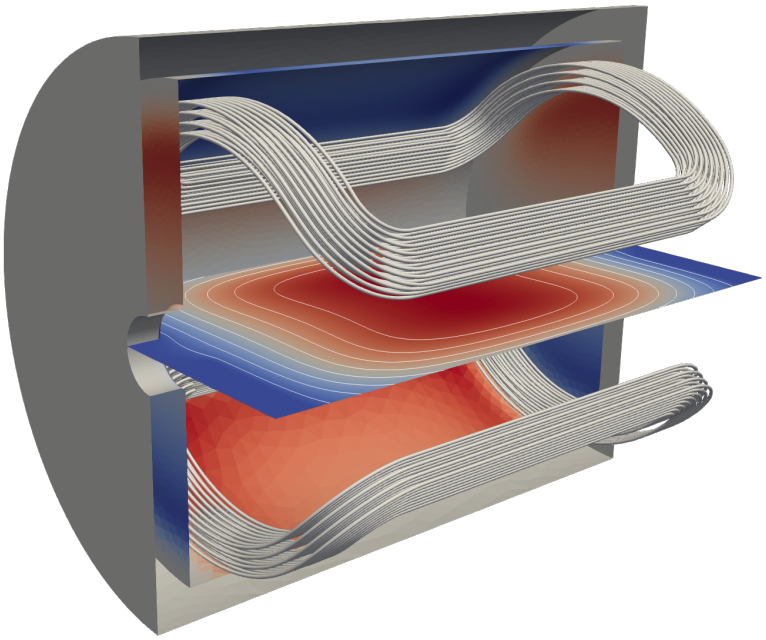

Figure 3: BEM applied to a magnetostatic problem.