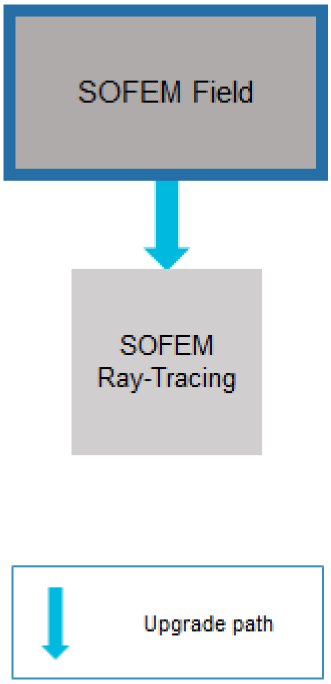
SOFEM Field

2D Second Order Field Computation



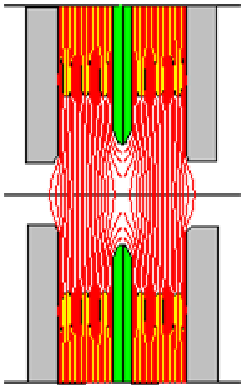
Overview

The SOFEM Field software computes the potential distributions of magnetic and electrostatic lenses using the Second-Order Finite Element Method. SOFEM Field is used to calculate the fields for several MEBS packages.

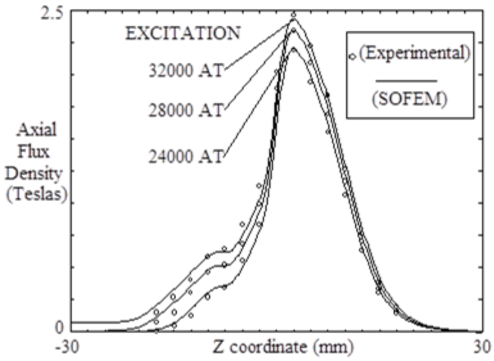
The program provides at least an order of magnitude greater accuracy than the first-order FEM for a given number of mesh-points. As successively more mesh-points are used, the relative accuracy with respect to the first-order method becomes progressively greater. The second-order method is also less sensitive to the distribution of mesh-points than the first-order method.

The numerical technique used in the software is the second-order finite element method (SOFEM). The space between the electrodes or polepieces is divided into a mesh of second-order finite elements, using linear Coons patches to perform the sub-division. Each finite element is a curvilinear quadrilateral with 9 nodes. The potential in each element is modelled as a bi-quadratic function on to a unit square in the isoparametric mapping plane. The potential distributions are computed by minimising an appropriate variational functional.

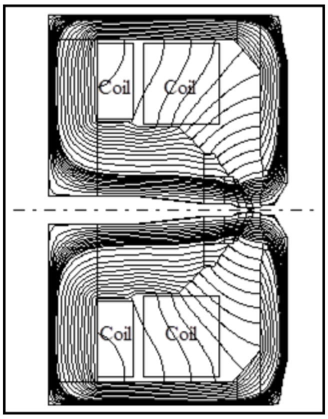
For electrostatic lenses, curved electrodes and dielectric materials can be handled easily. A set of basis solutions are computed, corresponding to 1 volt applied to each electrode in turn.



Electrostatic lens with curved ceramic insulators



Axial flux density in gap region, computed and experimental values

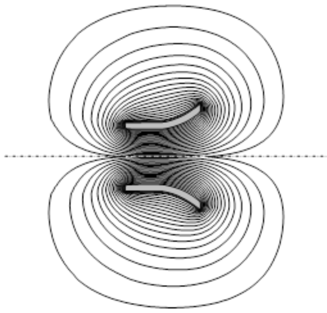


Highly saturated magnetic lens

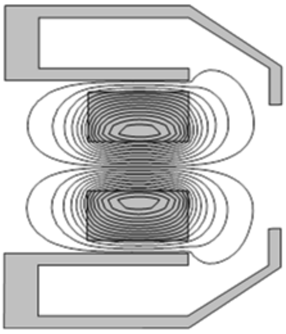
For magnetic lens field analysis, there are three programs. The first computes the magnetic scalar potential distribution in the polepiece region assuming constant permeability pole pieces. The second computes the vector potential distribution in the magnetic circuit and coil windings, again assuming constant permeability. The third program computes the vector potential in the magnetic circuit and coil windings, taking magnetic saturation into account, with numerically specified B-H curves, defined by the user.

Magnetic deflectors with toroidal or saddle coils can be handled, located inside rotationally symmetric magnetic circuits or wound on rotationally symmetric magnetic formers. The program computes the first, third and fifth harmonic components of the deflection field.

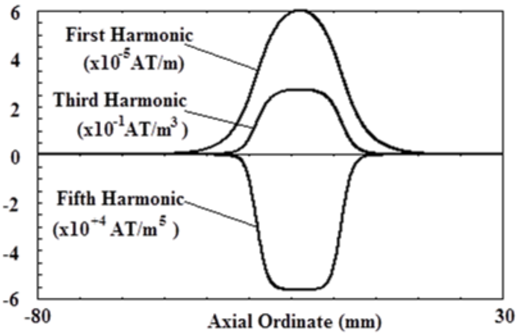
Electrostatic multipole deflectors can be handled. To enable the field to be computed as a set of multipole harmonic components, the electrostatic potential is assumed to vary linearly in the azimuthal direction in the azimuthal gaps between adjacent electrodes. Again, the first, third and fifth harmonics of the deflection field are computed.



Electrostatic deflector with curved electrodes



Toroidal deflector inside a magnetic lens



Computed deflection field harmonics for toroidal deflector

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