OPTIMIZATION FOR THE DESIGN OF ELECTRON GUNS

R. Lawrence Ives, Michael Read, Thuc Bui
Calabazas Creek Research, San Mateo, CA 94404 USA

Adam Attarian, William Tallis, Virginia Forstall, Cynthia Andujar, Hien Tran
North Carolina State University, Raleigh, NC 27606 USA

Creek Research, Inc. (CCR) is continuing development of optimization routines for design of both simple and complex electron beam devices. The principle computational tool is Beam Optics Analyzer (BOA), a 3-D finite element charged particle analysis program with electrostatic and magnetostatic solvers [1]. CCR is teamed with scientists and students at North Carolina State University to integrate advanced optimization routines into BOA. Previous reserach developed routines for optimizing cathode anode spacing to achieve a specified beam current, magnetic field registration to achieve a specified beam size, electrode geometry to minimize field gradients, and cathode shape to reduce beam ripple [2, 3].

These routines were recently used to design a doubly convergent multiple beam gun. Development of such an electron gun was impractical without the optimization capability of Beam Optics Analyzer. The design achieved a 16:1 area compression of the ensemble of electron beams without beam spiraling through the circuit region of the device.

The current effort is focused on design of magnetic circuits to achieve a user-specified magnetic field profile through a multi-coil solenoid with iron polepieces and shield. The routines will modify nine geometric parameters and five current values to achieve the desired profile. The effort will include definition of appropriate goal functions, optimization routines and interface to the parametric solid modeling program that serves as the geometry engine. Results of the development, including application to electron beam devices, will be presented.

1.Beam Optics Analyzer, information and download available at www.calcreek.com.
2. Brian M. Lewis, Hien T. Tran, Michael E. Read, R. Lawrence Ives, "Design of an Electron Gun Using Computer Optimization," IEEE Transactions on Plasma Science, Part 1, Vol. 32 Issue 3, pp. 1242-1250 (June 2004).
3. John A. David, R. Lawrence Ives, Hien Tran, Thuc Bui, Michael E. Read, "Computer Optimized Design of Electron Guns," IEEE Transactions on Plasma Science, Vol. 36 Issue 1, pp. 156-168 (February 2008).

* This work was supported in part by the U.S. Department of Energy under Grant DE-FG03-04ER83918