Phys-112: Computational Project

Numerical Solution of 2D Electrostatic Boundary Value Problem

Starting Date: Monday, 19 Feb. 2007
Due Date (strict): Wednesday, 28 Feb. 2007

Project:

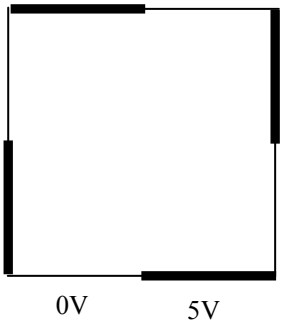
- The electrostatic potential in source-free region satisfies the so-called Laplace's equation, which becomes in 2D: $\frac{\partial^2 V(x,y)}{\partial x^2} + \frac{\partial^2 V(x,y)}{\partial y^2} = 0$.
- You can solve Laplace's equation by approximating the partial derivatives using finite differences as
$$V(x_i, y_j) = \frac{1}{4}\left[V(x_{i+1}, y_j) + V(x_{i-1}, y_j) + V(x_i, y_{j+1}) + V(x_i, y_{j-1})\right].$$
- You start with an initial guess (such as all zero potentials, except at the boundary nodes) then solve this finite difference equation iteratively over the mesh, until you reach convergence.
- Test your code with the 2D electrostatic problem supplied below, and preferably with additional ones of your own. Present your solutions in the form of two-dimensional surface/mesh plots.
- Each participant will submit a detailed, typeset **project report** including your formulation and your source code.
- The project is **not mandatory** but it can serve for those who would like to improve their overall course grade.

Other Notes:

- Most computational platform/languages are OK (like, C++, f77, F90, MATLAB, Maple, Mathematica, etc.) other than a special BVP package.
- Discussions among yourself are OK, but try to be original and distinct from anyone else; even unfruitful attempts can be included in your presentation.

Test Case:

Find electrostatic potential distribution inside the following 2D square region.



A square conductor with each side divided in half, has alternating values 0 and 5 Volts.