Assignment 06: Spectral Analysis and Relaxation Methods
Due Date: 11/11/2016

1.   Analysis of Sunspot data   [10 points]

The Solar Influences Data Center (SIDC) of the Royal Observatory of Belgium Center's website at `http://sidc.oma.be/sunspot-data/` provides data on solar activity such as the number of observed sunspots from 1749 to the present. Download the `TXT` file for the "Monthly mean total sunspot number" and read the description of the file's contents on the "INFO" page. You will likely need to manually edit the data file a bit to ensure that it can be read via `np.loadtxt`. Specifically, check the last few lines.

(a) Graph the sunspot number versus time

(b) Fit the data with a straight line and estimate the yearly rate of change of sunspot number.

(c) Remove the linear trend from the data and compute and plot a power spectrum.

(d) Use what you have learned about signal processing to analyze the results. Does the data contain any interesting patterns/features?

2.   A Lightning Rod   [10 points]

Calculate the electric potential and electric field near a lightening rod. Model this as a very long and narrow metal rod, held at a high voltage, with one end near a conducting plane. Of special interest is the field near the tip of the rod.

3.   The Parallel Plate Capacitor   [10 points]

Compare the scaling properties of the Jacobi and Simultaneous Over Relaxation (SOR) methods for the parallel plate capacitor problem shown in Figure 5.6 of the textbook. In particular, for a fixed accuracy (as set by the convergence test) compare the number of iterations N_{iter} required to find a solution vs the linear size L for a fixed $L \times L$ grid.

4.   Project Update   [5 points]

Provide me with an update on your project. This should be approximately one page long and include a properly formatted list of the references you have uncovered, updated project goals, a list of milestones, a project timeline (with dates), etc.