Math 126 Numerical PDEs: Homework 7—debriefing

February 29, 2012

1. [8 pts = 1+3+4]

   (a) Always good to do a geometry plot to check.

   (b) Rank increases to roughly 21 plus or minus one or two, by $N = 100$. Here's a cute vectorized way to fill the matrix given `y` a row vector of `N` sources as complex numbers, and `z` similarly for targets.

   ```
   d = repmat(y, [N 1]) - repmat(z.', [1 N]);
   A = -log(abs(d))/(2*pi);
   ```

   (c) Using ratio $b/R = 3/\sqrt{2}$, get $p = 31$ multipole degree needed for $\varepsilon = 10^{-10}$, using $p \geq \log(1/\varepsilon)/\log(b/R)$. If you included the total charge as a prefactor, you got a slightly higher p.

2. [8 pts = 2+4+2] See Brad's code.

   (a) Just reading in the file and setting up targets.

   (b) You should use the $p = 31$ from previous question, since these sources and targets lie in the same box geometries. Taylor did a nice convergence plot here showing p can be a bit less than this.

   (c) Norm is 9721.39640360853 to around 13 digits. I gave you the integer part so that you could debug (e.g. it's common to be off by 2π).

   Brad did a nice timing test, measuring 13000 times faster than naive algorithm in his implementation. Taylor reminds us that the naive calc would take several days!