Decreasing High Coil Current Densities in the NESCOILCUT Code

Neil Pomphrey 2/18/99

The "inner loop" of the NESCOILCUT code (see my 1/26/99 presentation) determines optimum currents in a fixed set of coils such that some cost function (eg $< B_n >^2$ at plasma surface) is minimized. To do this, we solve

$$Ax = b \tag{1}$$

for x, the $N-$vector of coil currents, where A is an $(M \times N)$inductance matrix and b is the $M-$vector of normal field values on the plasma edge. NESCOILCUT solves Eq. (1) using our familiar SVD package. This obtains the smallest $|| x ||$ which minimizes $r = || Ax - b ||$.

A simple modification of NESCOILCUT replaces Eq. (1)

$$\sum_j A_{ij} x_j = b_i$$

by

$$\sum_j (A_{ij}/w_j)(w_j x_j) = b_i,$$

i.e., solves

$$A'x' = b. \tag{2}$$

for the weighted coil currents $w_j I_j$. Again, we use SVD to minimize the residual, this time obtaining the smallest $|| Wx ||$. To drive down the current in a given coil (labelled by j) relative to another coil, we assign a smaller weight, w_j to that coil.

The (trivial) modification to NESCOILCUT has been made, and tested to see that the desired effect is produced. Naturally, there is a price to be paid in terms of the value of the residual r and therefore presumably of the ability to re-construct a free boundary equilibrium. A systematic study can be done at some later time.