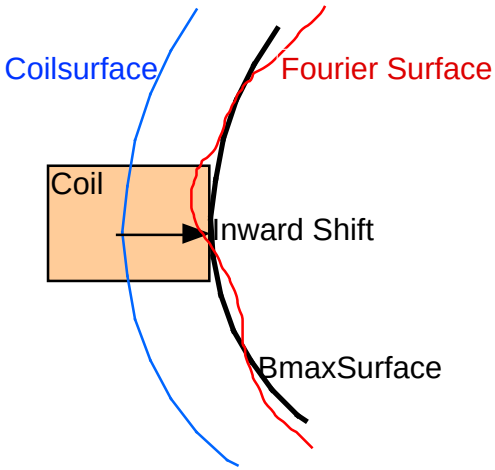
Calculation of B_{max} at coil surface / B_o in plasma using nescoil

P. Valanju, D. Williamson, A. Brooks, W. Reirson, March 4, 1999

- Calculation of $B_{max}/\langle B_o \rangle$ has been implemented (with Art's help) within Nescoil using nescoil green's function. This can now be used within an optimizer.
- B_{max} is calculated on a surface generated from the current-carrying surface at coil center by shifting by 1/2 coil radial depth in the inward normal direction.
- $\langle B_o \rangle$ is flux-surface rms value of B_o on plasma surface.
- Better and faster than what we used earlier, viz., shifting from plasma surface and using a fourier series for the surface.



Benchmarking has been done for qa3c10 case

- Dave has used the saddle+tfef filaments to generate coils with finite cross section and calculated $B_{max}/\langle B_o \rangle = 2.8$ using an isoparametric solid coil element model. (See Dave's presentation from last week's meeting at ORNL).

- After careful checking of all current normalizations, nescoil gives 2.41 for this case with the same saddles (but using sheet current solution). This is good agreement.

- The surface current value of 2.41 obtained with sheet currents is lower than the 2.8 obtained by Dave using solid coils. This is as it should be.

- The location of the B_{max} seems to agree with Dave's calculation. It is near where the surface current density is max on the inboard side.

Reactor scenario: Compare $B_{max}/\langle B_o \rangle$ with a tokamak case.

- For a reactor-like case (with all sizes scaled down by factor 5), following Wayne's suggestion, I used the qa3c10 case (R=1.5m) with modular coils at 0.32m and a coil half depth of 0.052m.
- I produced a "reasonable-looking" set of modular coils with 100 svd weights.
- For this set, at 0.052m from coilsurface, I get $B_{max}/\langle B_o \rangle = 2.59$ (to be compared with the 1.9 for tokamaks).
- This is better than the 3.4 I had reported earlier. The difference stems from the new surface-shifting method used – the earlier method gave surface undulations which were big enough to bring some points as close as 0.047m, and the B_{max} blew up.
- Though this ratio of 2.59 is 36% higher than the 1.9 for tokamaks, this was just a test case. We should be able to optimize this ratio down further using this tool which is now installed in nescoil and benchmarked.