Targeting island width within NESVD

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1. Objective and justification
2. Proposed method
3. Coding needed:
   - Existing codes that will be used
   - New coding needed
   - Estimated time for writing, compiling, and debugging

Objective

Design NESVD/OPT surface current solutions that *simultaneously*

1. Reduce the width of specified islands inside the plasma
   - Using estimator that is linear in surface current potential
   - On suspect plasma surfaces (from previous PIES runs)
2. Give good outer plasma surface reconstruction
   - Using surface Xerr or Berr targeting within NESVD/OPT
3. And can lead to acceptable coils
   - Using SVD scan to smooth solutions /OPT to vary surface

Justifications for undertaking this task

1. Need to suppress coil-generated islands
2. GA island suppression code (Miner and Wooley) needs a good "gene pool" from which to pick coils – else it may fail.
3. The (island width)^2 expression (Brooks NCSX Phys Dec 9,99) is linear in B => it CAN be incorporated within NESVD.
4. The (island width)^2 expression is very close to Xerr expression already in NESVD (Valanju NCSX Phys Jan19,99).
5. Xerr targeting suppresses Xerr at plasma surface as expected
6. Appears not hard to do. We have most of the codes needed.

Proposed Method

1. Use Wooley code and VMEC wout file to
   a. Locate resonant surface(s) to target and get iota' on them
   b. Calculate $(B\bullet n)_{plas\ res}$ on this surface from VMEC plasma alone
2. Find surface current potential φ_o by targeting Xerr (NESVD) on outermost plasma surface: $(B\bullet n)_o = (B\bullet n)_{vmec\ plas\ surf}$
3. Calculate $(B\bullet n)_{coil}$ from φ_o on the target resonant surface(s)
4. Use NESVD again to find φ_1 by targeting $(\text{island width})^2$ on resonant surface calculated from $(B\bullet n)_1 = (B\bullet n)_{coil} + (B\bullet n)_{plas\ res}$
5. $\varphi = \varphi_o + \varphi_1$. Pass this to GA, VMEC-Physics, and PIES.

Coding Needed

- Existing codes that will be used

  4. NESVD (or NESOPT) with Xerr or Berr targeting

  5. Wooley's code: to get from VMEC wout file to Resonant Surface info, (B•n) and iota' (write into file)

- New coding needed
  - NESVD (island width)^2 targeting (modify Xerr code)
  - Simultaneous (island width)^2 and Xerr targeting? (Version 2)
- Estimated time for writing, compiling, debugging, and first runs is ~3 work-weeks unless unforeseen problems pop up
- Develop code in parallel with GA-Island and NESOPT