

Plans to Validate Trim Coil Design

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Need to Still Answer the Following

- Is the present set of Trim Coils Adequate to target the 3/5 and 3/6 Islands that they were designed for?
 - Results prior to PVR with Island Healing Code were encouraging
 - Further demonstration planned after Island Healing Code Enhancements completed
- With more independent control over individual trim coil currents (or clusters of them) can other resonances be targeted?
 - Again, results prior to PVR were encouraging
- Can the same set of Trim Coils control Symmetry Breaking Field Errors?
 - Targeting of π resonance possible with CURROPT, but results not born out with field line tracing.
 - **Difficulty attributed to disagreement in surface location**
 - Efforts to improve surface target underway

Approaches to Improve Vacuum Configurations

- Work with Stuart Hudson to develop a version of his Island Healing Routine which does not utilize PIES
 - Motivated by need to handle Symmetry Breaking Field Errors.
 - Replace PIES vacuum field with separate routine (vacfield) which provides field from coils in suitable toroidal coordinates (ie VMEC)
 - Island Healing Routine can provide a more accurate surface on which to measure field errors
- Work with Mike Z to develop a module (vacisld) for STELLOPT to target B.n and/or resonant components of B.n on VMEC surfaces
 - If satisfied, VMEC result should be closer to PIES result
 - Implies VMEC result will indeed have surface.

Approach (from last Project Meeting)

Since VMEC and PIES enforce stellarator symmetry, studies will be done in vacuum using field line tracing, with Field Errors evaluated using CURROPT

- Choose (or generate) a reference vacuum configuration that contains the low order resonance(s)
 - For $\frac{1}{2}$ resonance, use Mike Z's li383m2.1.z55x case
- Perturb the coil set geometry
 - Simple code for manipulating coils has been written
- Observe Induced Islands with Field Line tracing
 - Use TRACE code
- Target Islands with CURROPT using existing trim coils
 - CURROPT has been modified to handle symmetry breaking field errors
- Introduce additional trim coils
 - Follow Coupling Matrix Approach for Design

Modified Approach

- Difficulty with prior approach believed to lie in poor agreement of assumed resonant surface location and that seen from field line tracing.
 - Targeting B_n in STELLOPT should produce better agreement
- Use existing healed configurations (ie from beta-I scan) and impose field errors perturbations (ie from coil geometry errors)
 - **Get targeted surfaces from Island Healing Code**
 - Use curropt to set trim coil currents to cancel field errors
 - Use PIES to validate approach works on symmetry preserving field errors
 - Use curropt on above surfaces to test adequacy of Trim Coils on Symmetry Breaking Field Errors
- Use Stand Alone Island Healing Code in Vacuum to test adequacy of Trim Coils on Symmetry Breaking Field Errors

Summary

- Trim Coil Validation requires **demonstrating** good surfaces can be obtained by correcting field errors (both symmetric and symmetry breaking)
- Using $[B^s/B^\phi]_{m,n} = 0$. on resonant surfaces to validate Trim Coils requires accurate knowledge of targeted surface:
 - From Island Healing Code
 - Improved VMEC Solution thru targeting $[B^s/B^\phi]_{m,n} = 0$. and $B \cdot n = 0$.
 - **Surfaces that are just “close” can produce poor results**