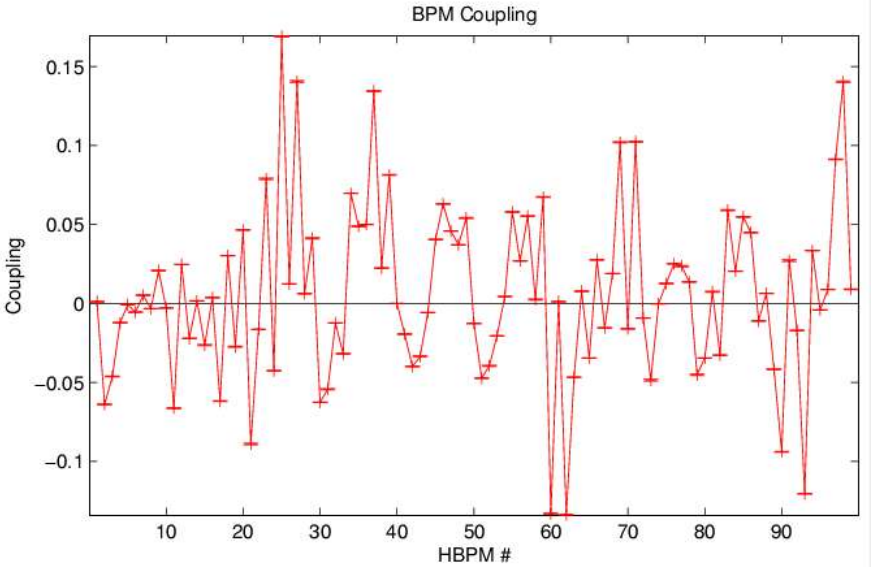
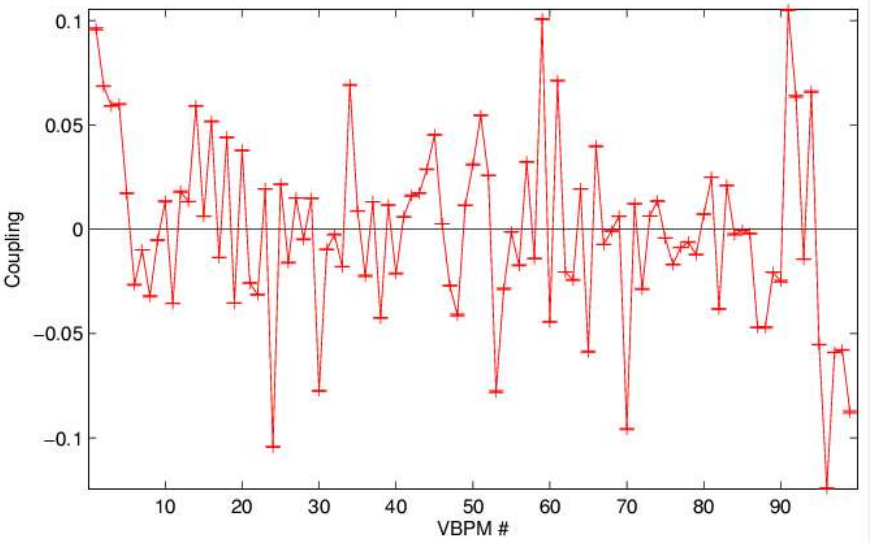
Simulated ORM Data for LOCO

- Simulated data generated using BMAD Closed Orbit Calc routine
- Misalignments included at this time:
    - Quads, bends, sextupoles: ring_ma misalignments (offsets, tilts/rolls)
    - BPMs: Offsets, tilts, BPM resolution limit (10μm “noise”)
    - Wigglers NOT misaligned for now (offsets initially caused issues with tracking)

Initial Test

- Introduce all possible errors / misalignments, and see if LOCO can determine misalignments
  - Appeared to be very successful – starting at ~200μm, corrected ORM to within BPM resolution (~7μm)
  - However, difficult to determine BPM tilts from LOCO output
  - How is "BPM Coupling" calculated, and what is the scale?
  - Second test proposed: introduce one large BPM tilt, with no other errors; LOCO will find the tilted BPM, and this will yield the scale of the BPM Coupling graph

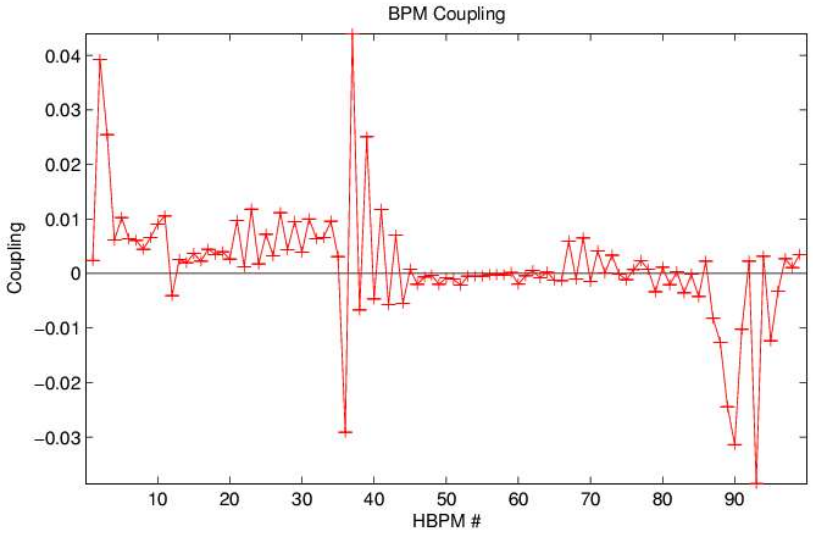


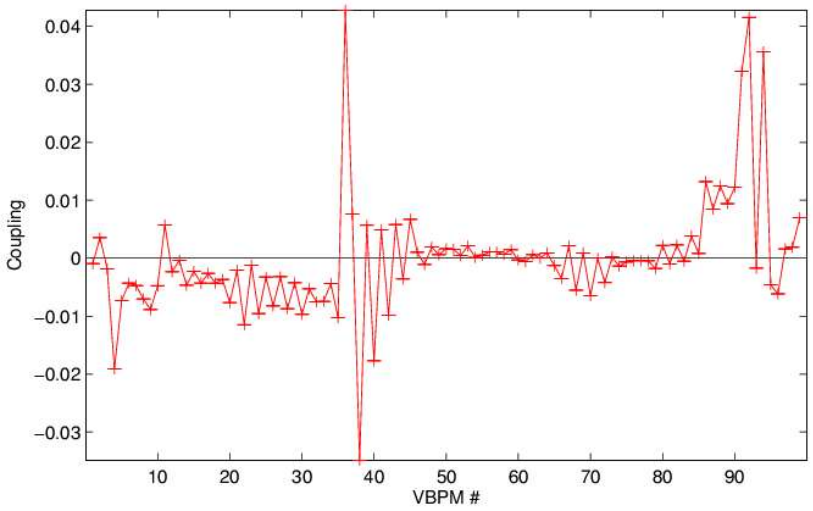


Single BPM Tilt

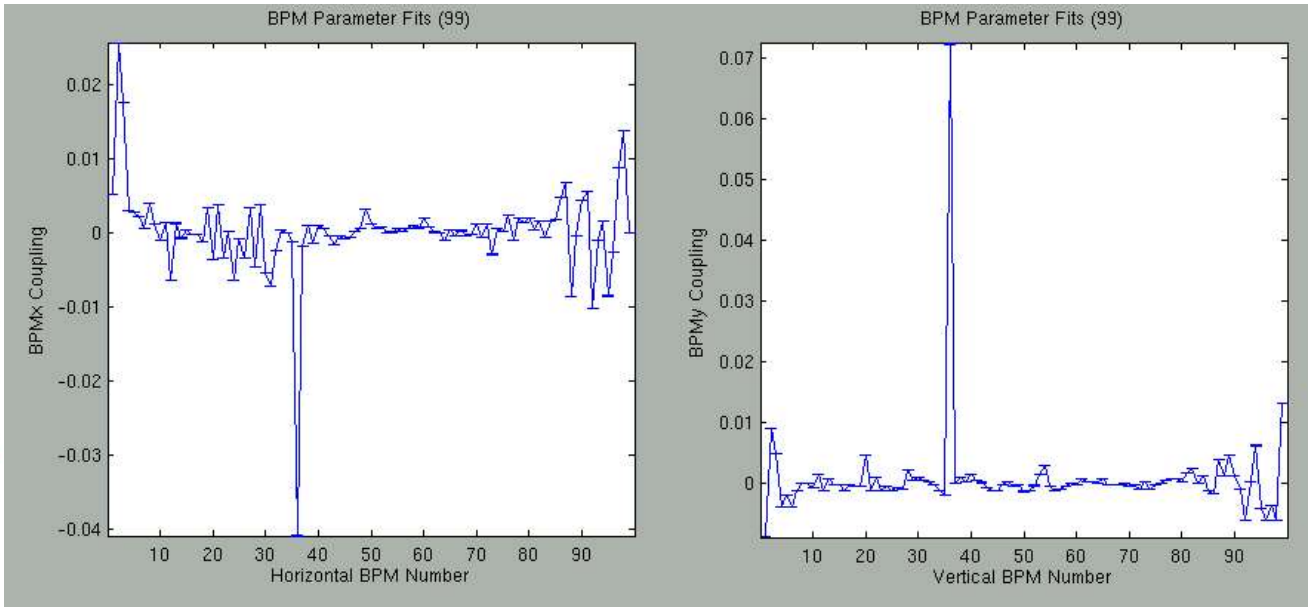
- When one large BPM Tilt was introduced (1000mrad, BPM#36), LOCO appeared to find the tilted BPM within one iteration (see next slide)
- HOWEVER-- a few problems:
  - Further iterations diverged; third iteration yields χ^2/D.O.F = NaN?
  - Coupling near IP L0 attributed to BPM tilts!
- When BPM resolution is introduced, two iterations can be run; peak at BPM#36 became much sharper, and coupling near IP L0 appears much smaller (see next slide)

Single BPM Tilt (ct'd) – BPM 36





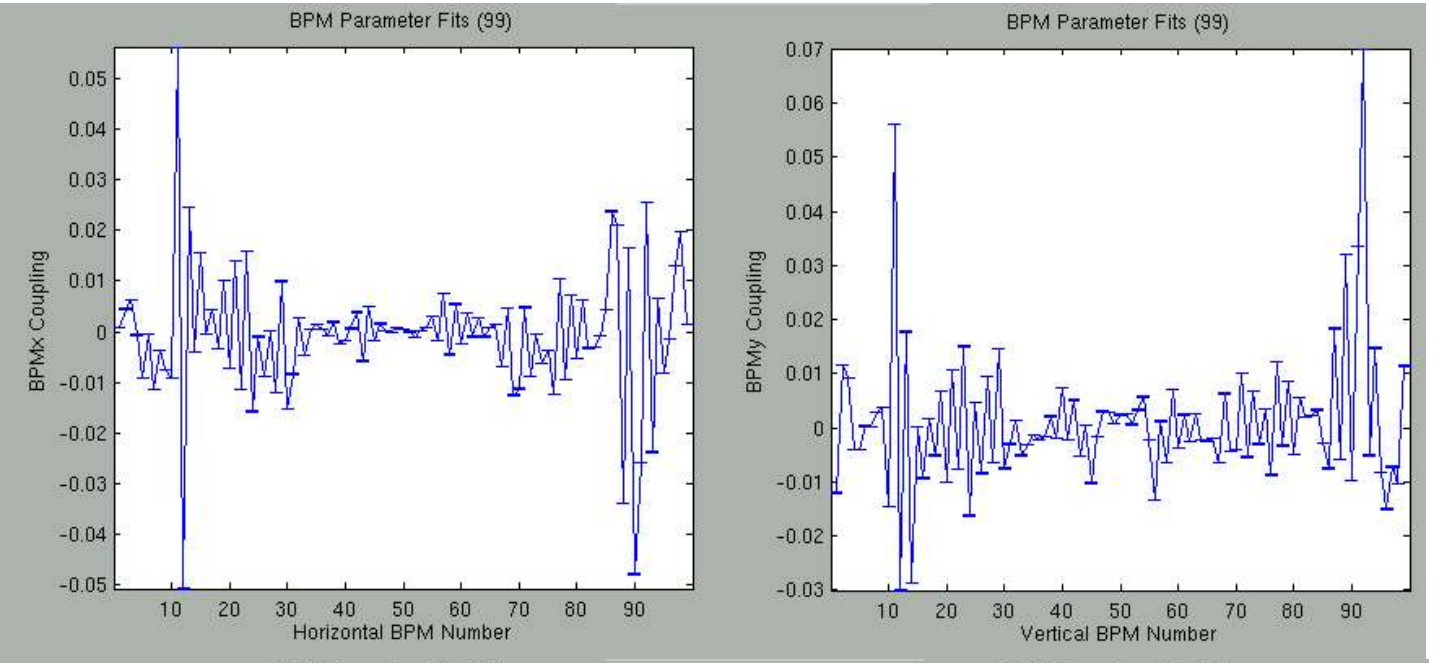
No BPM resolution included,
1 iteration in LOCO



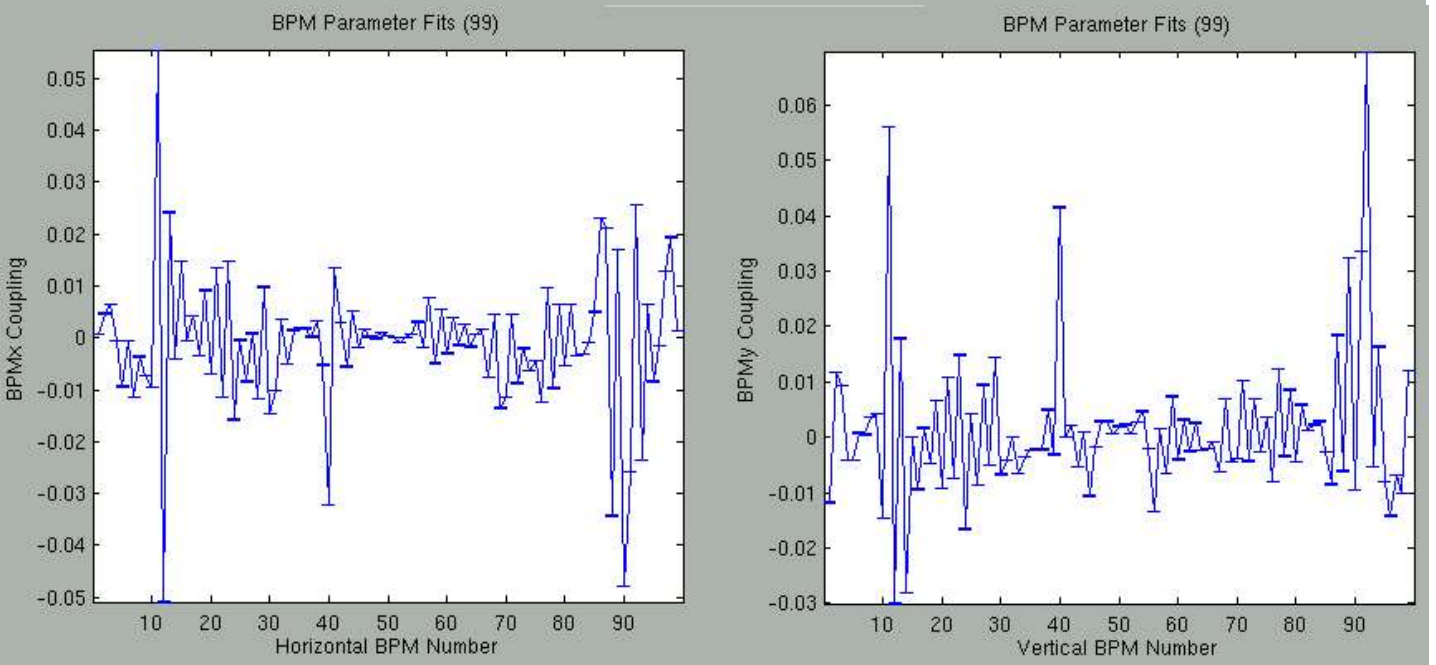
BPM resolution of 10μm, 2 iterations

Single BPM Tilt – Magnitude of Tilt

- Series of tests: vary the magnitude of the tilt (BPM#40 now), and see how well LOCO is able to isolate the misalignment; no other misalignments or BPM resolution for now



100mrad

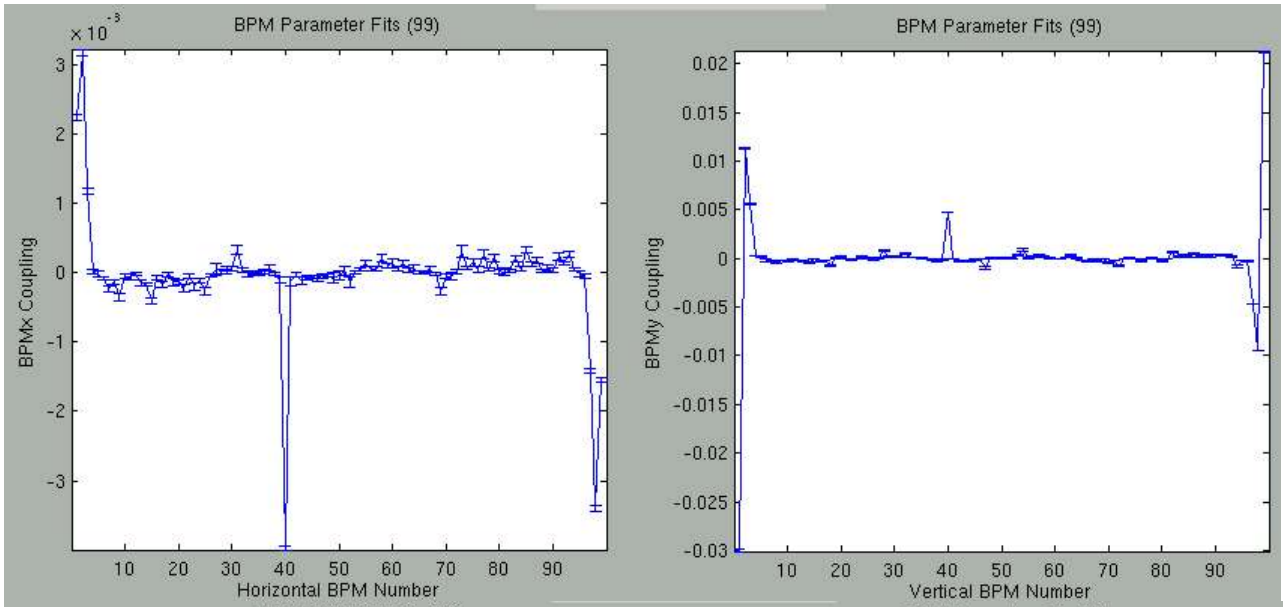


1000mrad

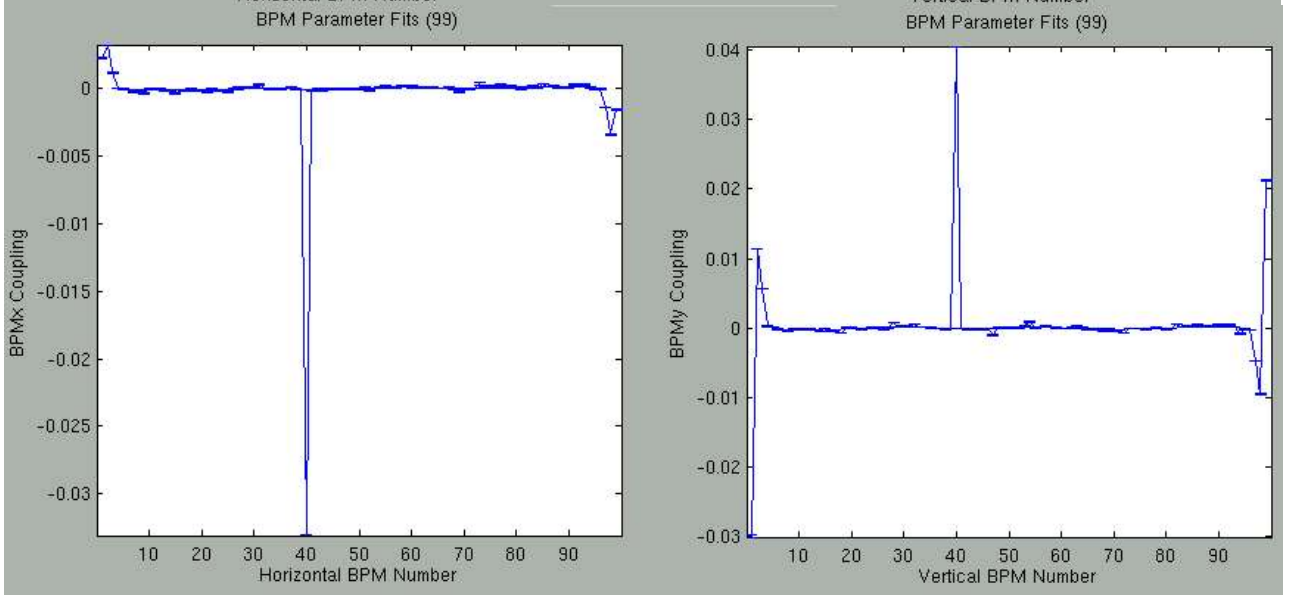
Single BPM Tilt – Magnitude of Tilt

- Next test: Same setup as before, but this time only allow BPM tilts to vary; 3 iterations were run (minimization converged after second iteration, further iterations did not diverge)

- Allowing for full misalignments with one additional large BPM tilt yielded noisy graphs, with no peak at BPM#40. (plots excluded for now)



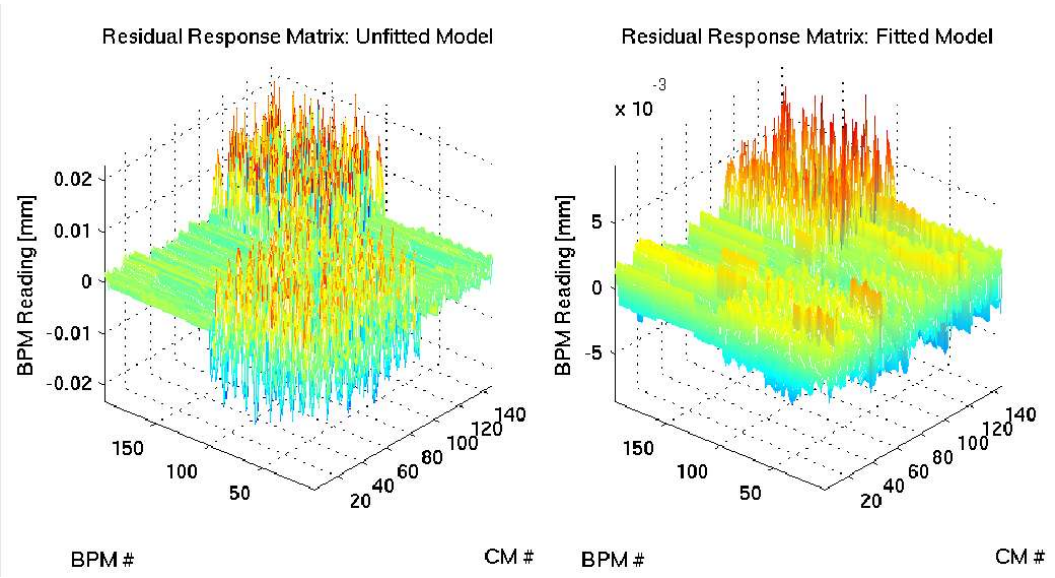
100mrad, no other errors



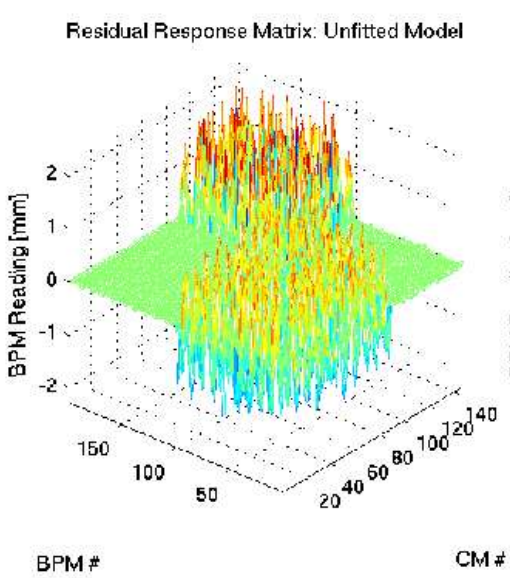
1000mrad, no other errors

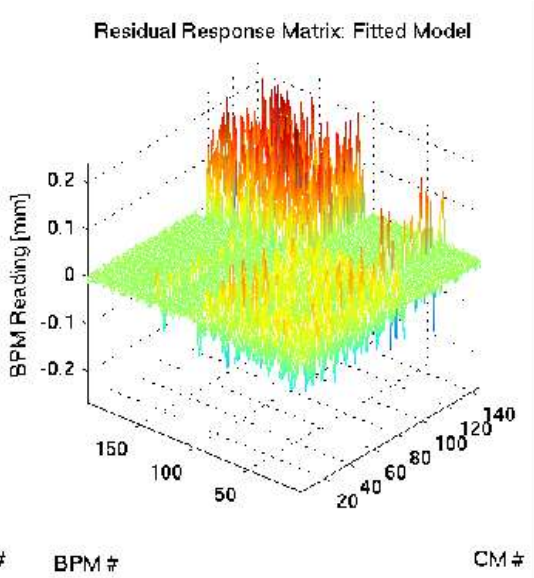
Single BPM Tilt (ct'd)

- LOCO does not appear to locate the single BPM tilt until a threshold of ~100mrad; even then, the magnitude of BPM coupling at BPM 40 still appears to be much less than the coupling attributed to the BPMs near the IP unless only BPM tilts are allowed to vary
- Upon further analysis, it became apparent that the quality of the fit in the single-BPM-tilt tests was significantly lower than that of the original (all errors included) simulated data tests
- Additionally, the BPM coupling graph scales are roughly an order of magnitude lower in the single-BPM-tilt tests, when compared to the actual results of the actual June '05 results



Original simulated data (10-micron resolution limit)





Simulated single BPM tilt

(no resolution limit or other misalignments)

Next Steps

- Determine how LOCO defines “BPM coupling” in the actual MATLAB scripts, and see if that yields an inherent scale for the plots
    - in progress... code is slightly obfuscated; definition of BPMCoupling difficult to locate
- Also attempt to determine how LOCO is minimizing the difference between model and measured data; why does LOCO have a difficult time with one single misalignment, when it seems to work well with every element misaligned?
- Walk through code and see what would be necessary to allow solenoid and other custom elements at IP L0 to vary during optimization process
- Convert a CesrTA lattice to LOCO-compatible format, and see how LOCO does with misalignments in that lattice
    - Advantage: no unusual elements at IP in CesrTA lattice; should be able to isolate single BPM tilt without any problems