NSTX

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Plasma Simulation Platform Update: PCS, Toksys, Simserver

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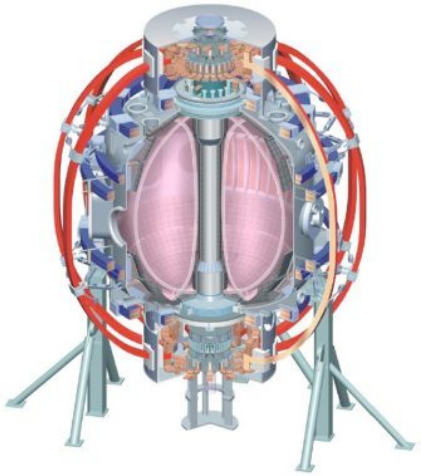
Apr/8/2011



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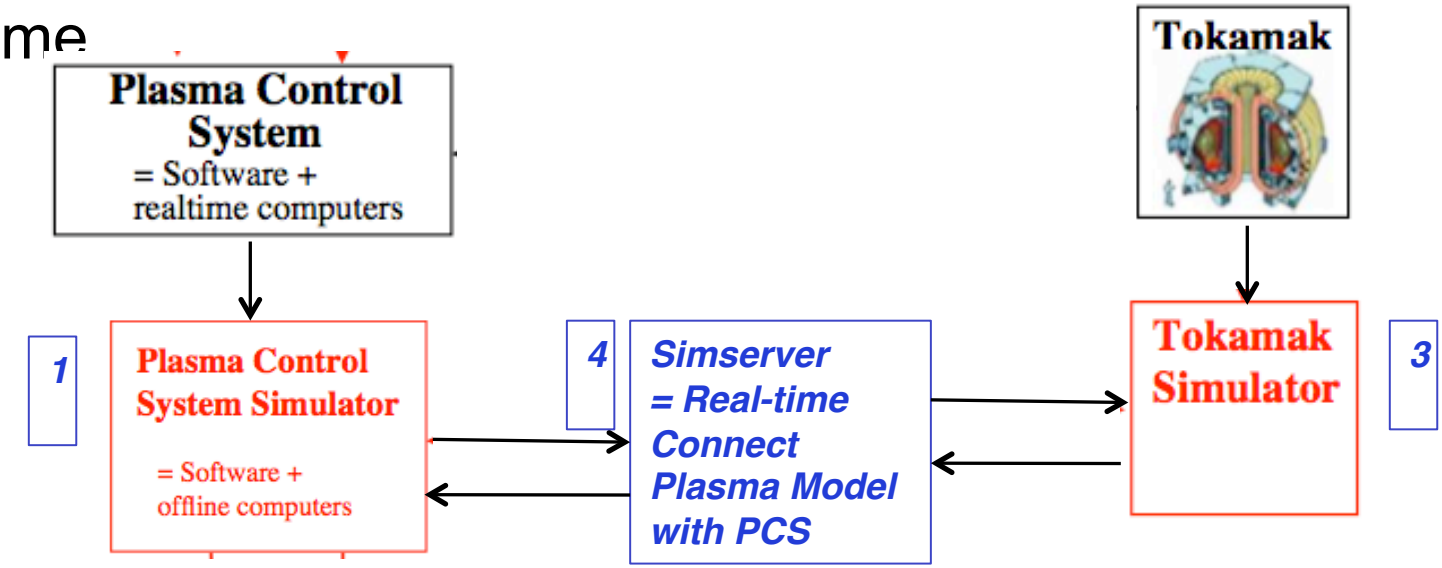
Developed Capabilities

1. Simulate PCS realtime computers on other machines. With input from Keith, now can simulate the updated PCS.
2. Ability to run PCS tests with mds data (no dynamics)
3. Ran/Tested plasma simulations with TokSys plasma model.
4. Simserver: Ability to connect the plasma model with PCS in real-time



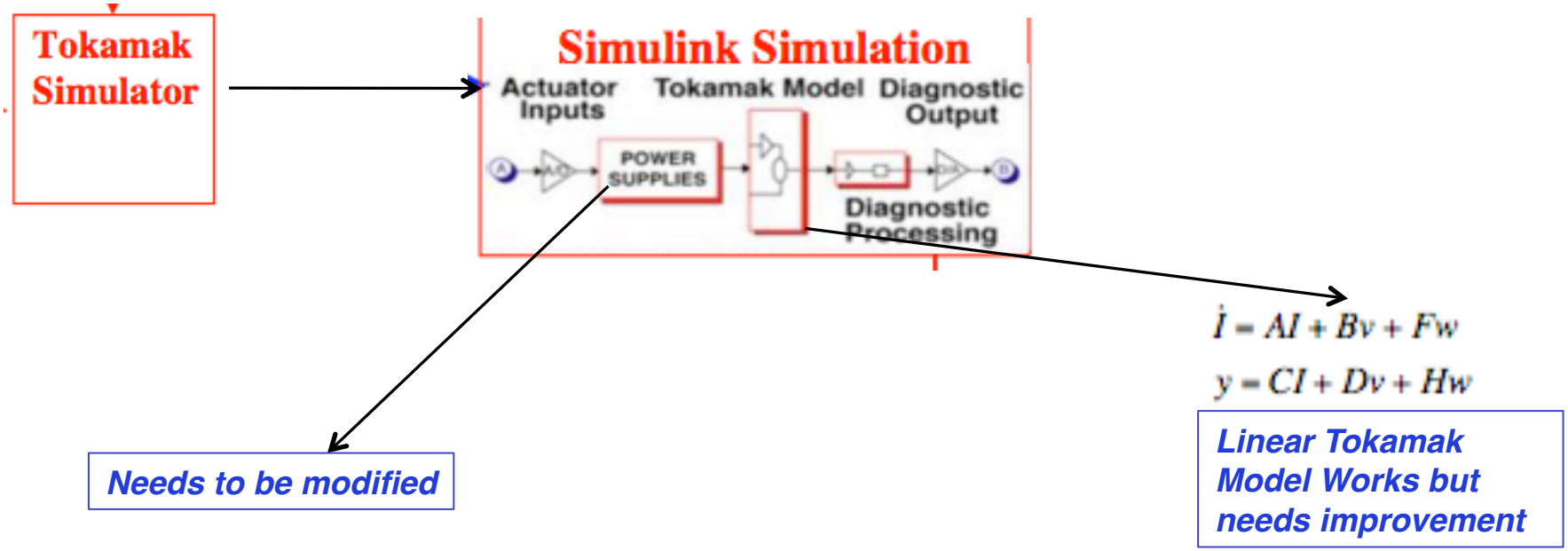
What is the use?

1. Currently, we can take MDSplus data or Isolver equilibrium
2. Define a linear plasma model for that system.
3. Run a closed loop (PCS + Simserver + PS + Plasma Model + Diagnostic Model) simulation.
4. Find the response of the coils and plasma
5. Change the PCS control algorithm
6. Rerun the algorithm to see the effect of the new control
7. Test and tune the control offline.

- In MIMO Shape Control, we will use this capability.

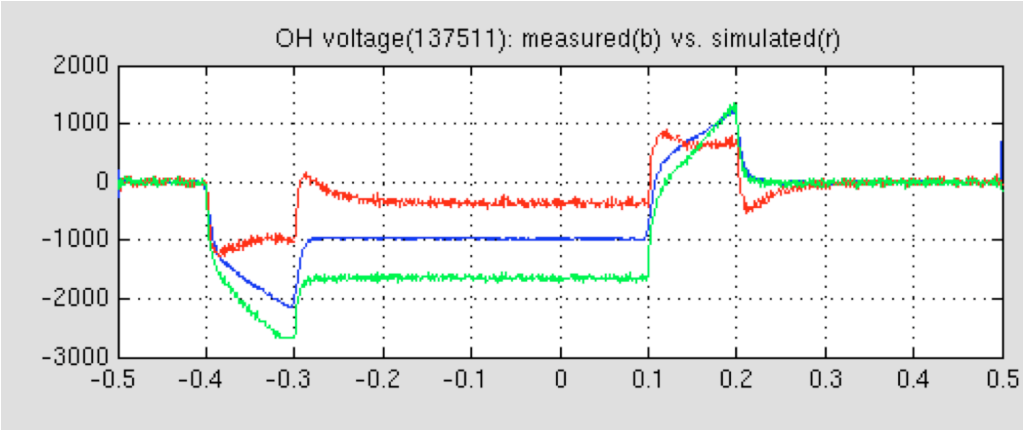
What is missing?

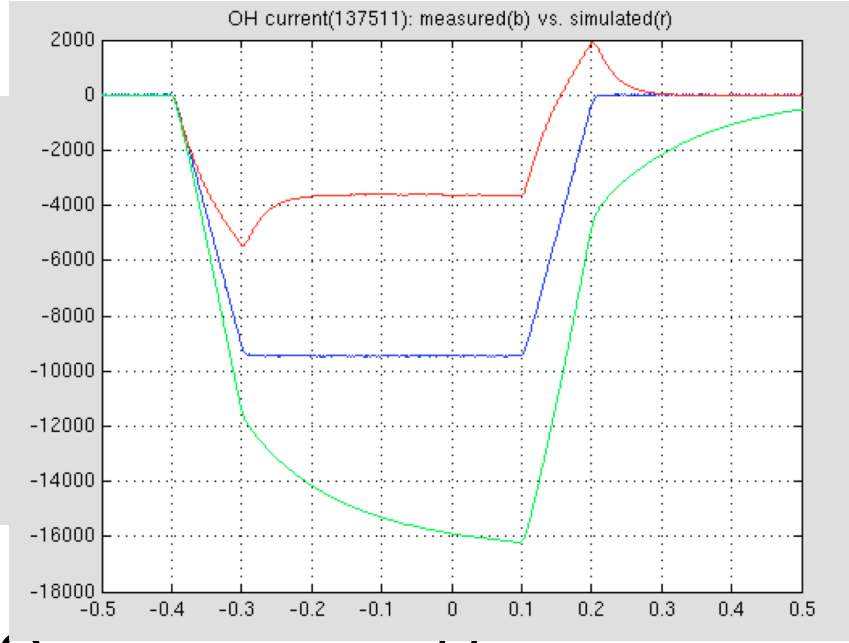
- Tokamak Simulation consists of PS, Tokamak and diagnostic model.
- PS model is not working properly needs to be modified.
- Tokamak Model is OK but needs improvements.



Power Supply Model

- I went through Ron's model and fixed it as much as I can. Ex:

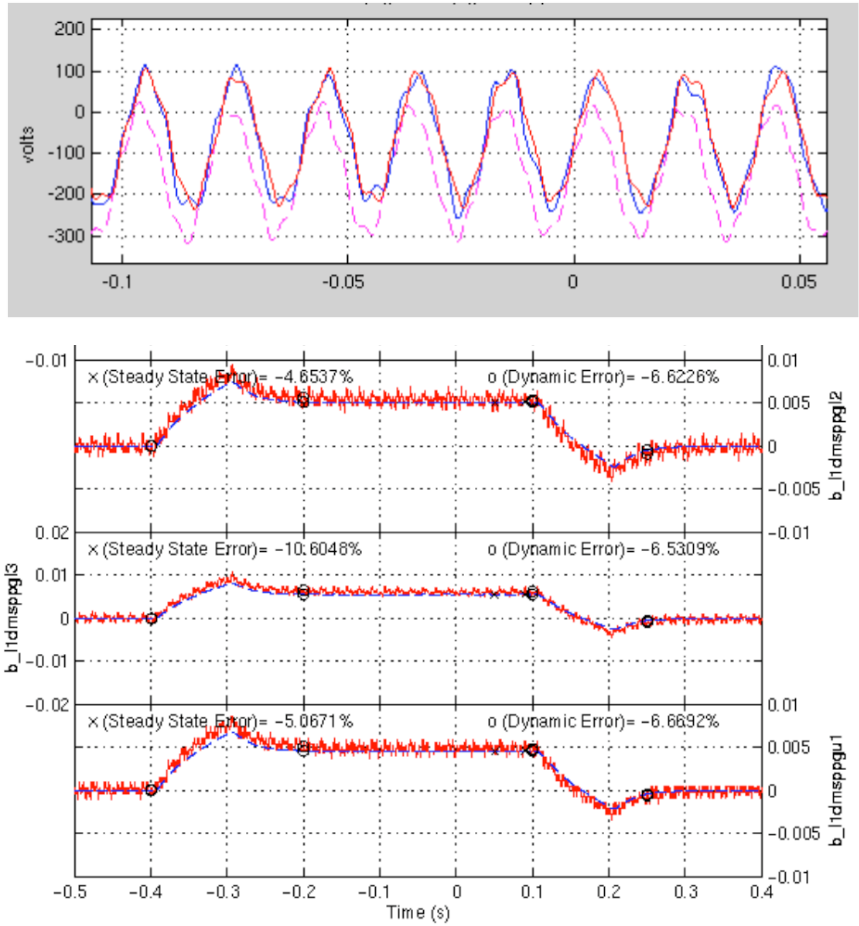




- Blue data, Red previous model, Green improved by me.

- But, it is essential to have a better model for simulations to make sense.

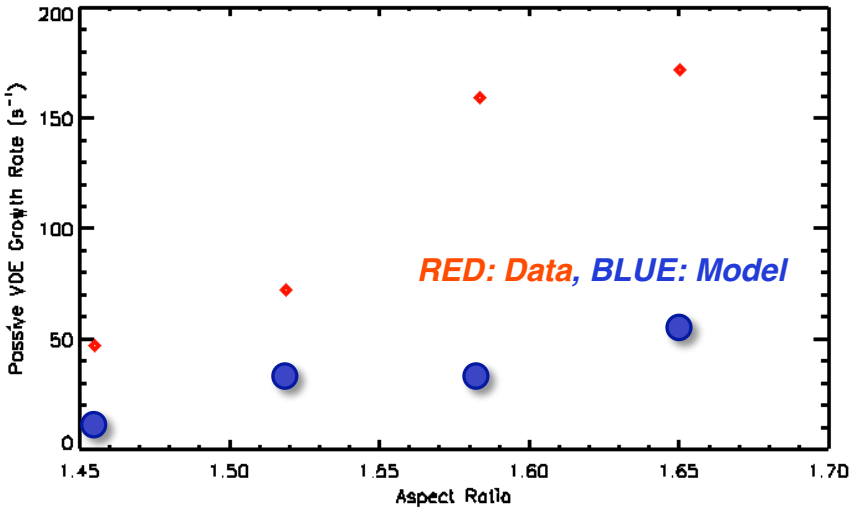
Plasma Model: How was it Obtained?

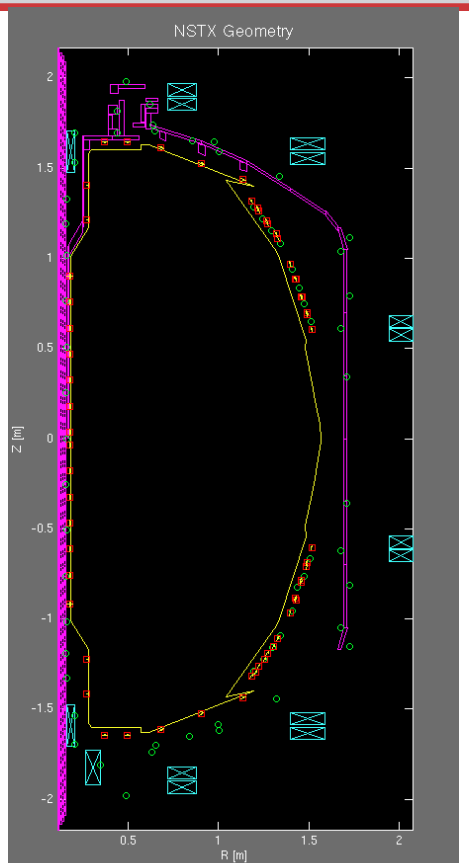


Comparison of model/experimental B-Probe traces for OH coil. Red trace is experiment, blue trace is model. Steady state and dynamic error values are % differences between model & exp and are defined between X's for steady state and O's for dynamic.

- It is a linear set of circuit equations.
- Set of System ID experiments on NSTX 2003-4.
- Model obtained to fit the sensor/probe measurements as good as possible.

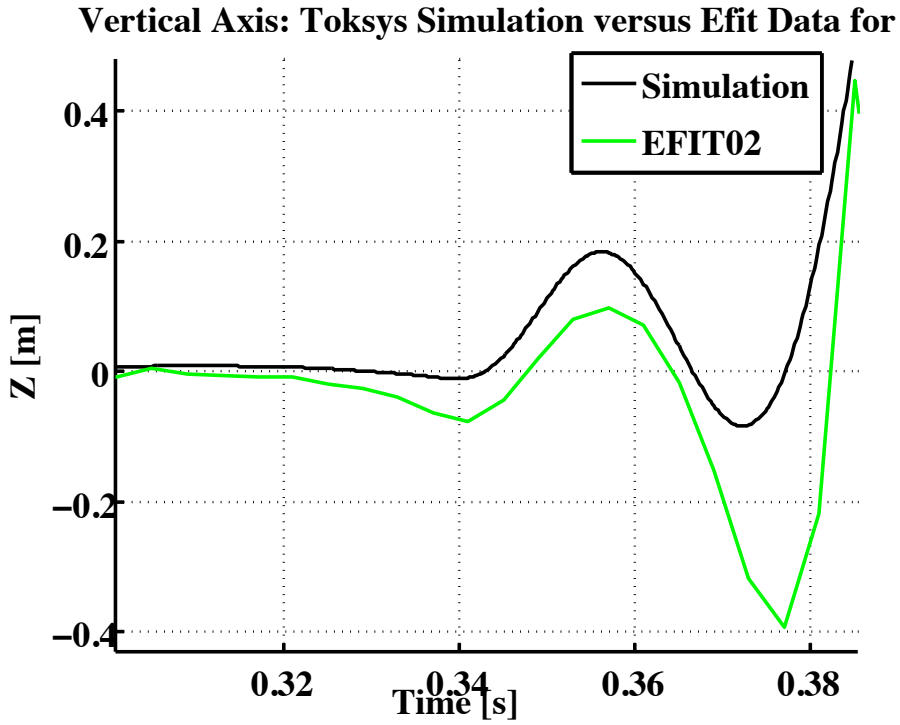
Plasma Model: Improvement to Vessel Model

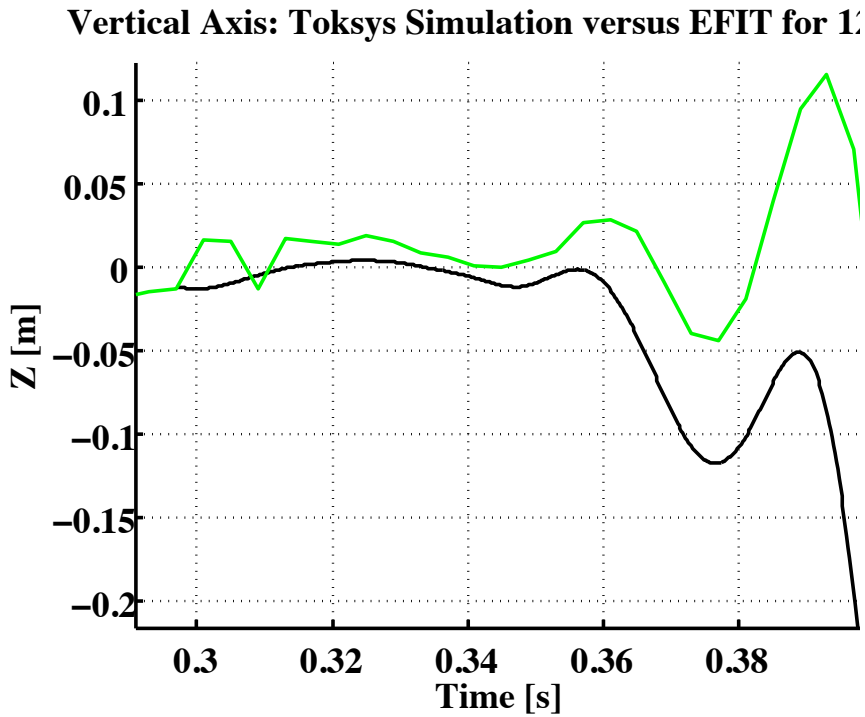




- Plasma Model is not perfect. Currently one piece vessel model is used. I am changing this to multiple chucks just like in the real NSTX (Work on this at GA). I expect the discrepancy between data and simulation to reduce as a result.

Plasma Model: OK for General Trend





- General plasma behavior is captured by the plasma model
- My work focused on vertical motion and vertical instability. The trends are OK.

P-TRANSP

- P-TRANSP integration into this structure.
- Collaborating with R. Andre to define the P-TRANSP structure to be able to read control inputs.
- Time P-TRANSP sim>>PCS+Simserver sim, i.e. time nonissue
- Exchange data through Simserver every 200 microsec.
- All we need is an interface.