Plasma response in JT-60SA baseline scenarios and EFCC applications

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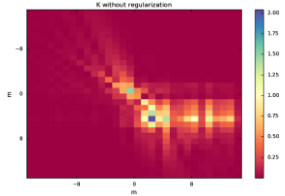
Coil current (references) calculated from plasma response



SVD

$$b^*_{ovlp} = \sum_m V_{mn} \times b_{m,ext}$$

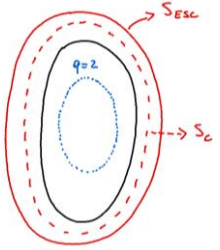
$$B_{OVLP}(t) = b^*_{ovlp} \cdot I^{EF} = \left|b^*_{ovlp}\right| I^{EF} e^{i(\angle b^*_{ovlp})}$$

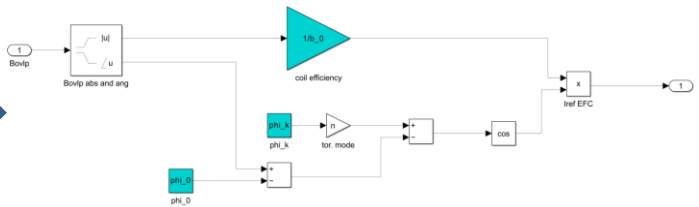
Mutual inductance between radial field perturbation (B^1) and poloidal component of equivalent current (J^2) is calculated numerically

- Used to calculate response to *m* independent perturbations
- Fourier harmonics of vacuum fields on the control surface **coupled** to harmonics of plasma response in the plasma region
- As a result, plasma response to any external field that can be recovered with the given range of harmonics

$$\begin{bmatrix} b_1^{pla,1} & \dots & b_1^{pla,j} \\ \vdots & \ddots & \vdots \\ b_m^{pla,1} & \dots & b_m^{pla,j} \end{bmatrix} = \mathbf{K} \begin{bmatrix} b_1^{vac,1} & \dots & b_1^{vac,j} \\ \vdots & \ddots & \vdots \\ b_m^{vac,1} & \dots & b_m^{vac,j} \end{bmatrix}$$

Using a proxy EF we can obtain correction current references for each scenario

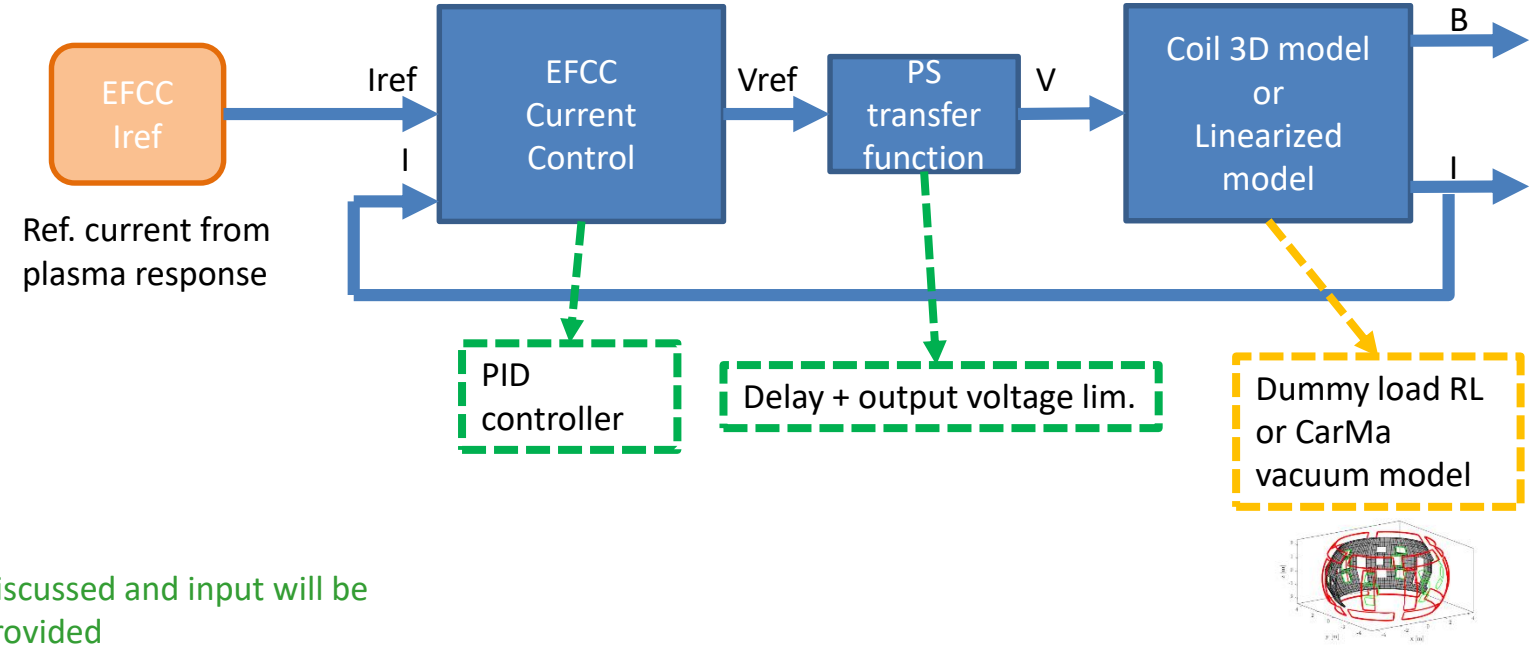




$$\begin{cases} I_i = I_0 \cos(n\phi_k - \phi) \quad k = 1, \dots, K \\ I_0 = -\dfrac{B_{OVLP}}{b_0}\ [kAt] \\ \phi = \alpha - \phi_0 \end{cases}$$

$V_{m,n=1}$ = complex vector for 1st SVD mode (from MARS − F)
$b_{m,ext}$ = 2D Fourier decomposition of external field (EF)

References will be fed to simulation of coil current control



- Discussed and input will be provided
- Discussed, options available, TBD

Towards SOFT 2024*:

*Modelling-driven requirements for Error Field Control Coil application to initial JT-60SA plasmas

- ✓ Plasma response workflow executed for two scenarios:
  - B=1.77T; Ip=2.1MA
  - B=1.77T; Ip=3.2MA
  - Other cases possible
- ~ Input from power supply tests for current control simulation
- ✘ Implementation of proxy EF and overlap calculation

✓ Done
~ Ongoing
✘ To do