Understanding Tungsten

Scenario Following Similar Ideas as in Simulation

- N. Eidietis et al., [4]

Actuators:
- Gyrotrons
- E coil

Controllers:
- Magnet: \( q, \varphi \)
- Kinetic: \( W, T \)
- ECH: NTM

Controller manager: uses controller commands and control priorities to calculate optimal actuator commands within physical saturation limits

- SAEH: Off-Normal Fault Response (ONFR) [5]; Switches control priorities in real time (e.g. use gyrotrons for NTM control vs. E coil control)

- Except for reduced ECH

The goal is to achieve the scalar evolutions of plasma 2 from the feedback simulation

Maximum ECH simulated, which results in evolutions far from Plasma 1, but attainable

- Integrated architecture

- Integrated Control

- Integrated Control of Individual Scalars to Regulate Profiles and Improve MHD Stability in Tokamaks

- Integrated Control of Individual Scalars to Regulate Profiles ...

- Mode suppression by localized ECCD, which is planned for ITER [1]

- Algorithms to track rational surface \( R_{ES} \) with ECCD \( \langle P_{EC}, \rangle \) developed in DIII-D [2]

- May need additional NEUTEC heating to achieve pre-NTM values \( R_{ES} \), which modify \( q, \varphi \), and \( W \) = NTM control, coupled with scalars control

- Integrated architecture includes supervisory and exception handling (SAEH) algorithms and actuator manager(s) (more on this later)

Simulations Test Architecture in High-\( q \) Scenario to Achieve High Performance, HTM-Free Operation

- Plasma 1: simulated with experimental inputs from shot 172538
  - Except for reduced ECH, which results in 2.1 NTM development

- Plasma 2: simulated with experimental inputs from shot 172538
  - Except for slightly lower \( L \) (0.05 MA)
  - Maximum ECH simulated, which results in no NTM development

- Plasma 3: simulated with inputs determined in feedback
  - The plasma starts from the conditions and inputs of the first simulation
  - The goal is to achieve the scalar evolutions of plasma 2 using feedback
  - The feedback scheme does not know the required inputs for plasma 2

- Current profile:
  - Central safety factor, \( q_c \)
  - Edge safety factor, \( q_e \)

- Rotation profile:
  - Volume-average rotation, \( \bar{\Omega} \)

- Pressure profile:
  - Thermal stored energy, \( \bar{P} \)

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