

# Hardware-in-the-loop Validation of an MPC Architecture for Real-Time Equilibrium Control at RFX-mod2

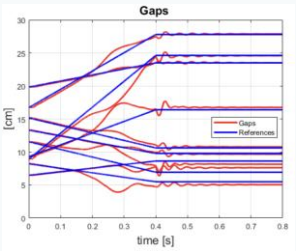
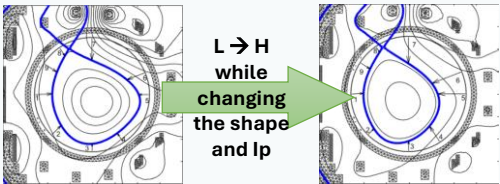
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**Contribution**    Prototype and HIL assess of a MPC control architecture for tokamak equilibrium control at RFX-mod2

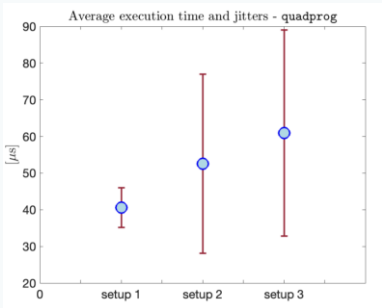
## Main questions answered

**Q1**    Is it possible to achieve tokamak MIMO equilibrium control via MPC on RFX-mod2, guaranteeing a relatively fast closed-loop response (RFX-mod2 pulses last ~1s)?  
**YES (of course!)**

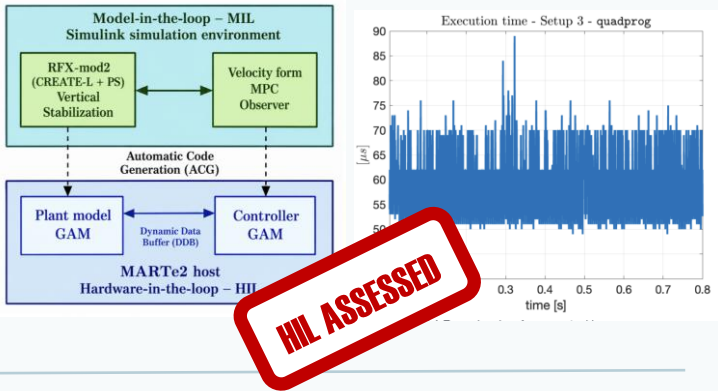


**Q2**    What are the parameters that affects the most MPC execution time (i.e., the time needed to solve the corresponding constrained QP problem)?  
**The prediction ( $N_p$ ) and control ( $N_c$ ) time horizons (i.e., the optimization variables)**

| Setup   | $f_s$   | $N_p$ | $N_c$ | $N_{step}$ | $n_{red}$ |
|---------|---------|-------|-------|------------|-----------|
| Setup 1 | 0.5 kHz | 32    | 4     | 2          | 45        |
| Setup 2 | 1 kHz   | 64    | 4     | 2          | 45        |
| Setup 3 | 2 kHz   | 64    | 6     | 3          | 35        |



**Q3**    Is it possible to solve the constrained QP problem meeting the real-time deadlines in due time using off-the-shelf tools?  
**YES**



## Important outcomes

**O1**    MPC control is effective and requires reliable models  
Can be enhanced with data-driven adapting policies (WIP...)

**O2**    *“All solvers are equal, but some solvers are more equal than others”*

