

ADAPTIVE PLASMA CURRENT CONTROL IN RFX-MOD

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Plasma current control was experimented in the RFX machine in early Nineties with unsatisfactory results due to the frequent onset of unstable regimes leading to increasing voltage demand and saturation of the flat-top power supply [1]. Plasma current control turns out to be more challenging in RFP than in Tokamak devices due to the higher plasma resistance value and fast dynamics. More recently, the active control system of MHD modes in RFX-mod has allowed a significant improvement in the quality of the discharges, limiting the wall interaction even at high plasma current [2]. An analysis of experimental data has allowed to derive typical values of plasma resistance in different plasma phases and to highlight its relation with other characteristic discharge parameters, such as MHD equilibrium parameters and density. In these new operating conditions and taking advantage of the flexibility of digital systems, the plasma current control has appeared feasible again.

A zero-dimensional model has been used for the design of a controller for flat-top operation. Numerical simulations have been successfully run and the controller robustness has been also tested in case of a sudden plasma resistance variation. The digital implementation has allowed a flexible control strategy with different control laws depending on the actual values of selected plasma parameters.

A design of the regulator according to adaptive control techniques is presented along with the definition of transition rules through the different phases of the pulse [3]. In particular, a real time estimation of the plasma resistance on the basis of the available magnetic measurements has been used to drive the control system through different regulators in a stable transfer mode.

The paper presents, in addition, the results of experimental campaigns which have been carried out using the new plasma current controller. An example of current-controlled discharge is shown in fig. 1.

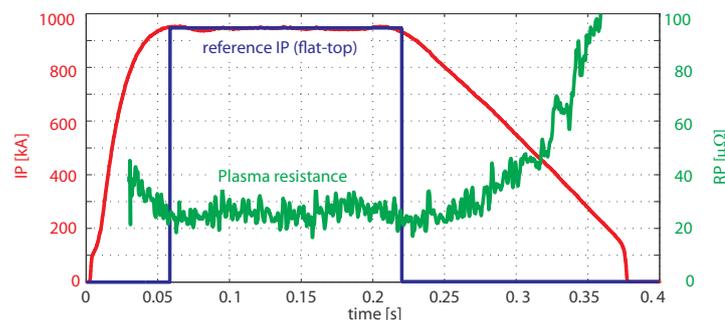


Figure 1: Experimental measure of RFX-mod plasma current and plasma resistance (#27552)

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[2] Marrelli L. et al. Magnetic self organization, MHD active control and confinement in RFX-mod *Plasma Phys. Control. Fusion* 49 (2007) B359-B369

[3] J. Hespanha and A.S. Morse, Switching between stabilizing controllers, *Automatica*, vol. 38, no. 11 (2002), p. 1905-1917