MHD control system optimization to RFX-mod real passive boundary

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The RFX-mod experiment routinely uses state of the art feedback active control of MHD instabilities [1] to extend its operational space and improve the overall plasma performances. Depending on the characteristic frequency considered however, the passive boundary can affect in different ways the features of the feedback control strategy used and ultimately reduce its effectiveness. One possible way to analyse this fact, is by studying how the coupling between actuators (192 saddle coils) and inputs (mainly 192 saddle sensors) can be described in the control loop. In normal RFX-mod closed-loop operations the Identity matrix is chosen to represent the mutual coupling matrix, but this turns out to be only a rough approximation of different possible coupling phenomena. The search for further optimizing feedback system operations for advanced MHD control recently showed how the characteristics of a realistic, 3D, passive boundary can be taken into account and implemented in the control logic through different realizations of this coupling matrix.

The paper extends this concept originally presented in [2] and presents the development and the implementation of different decoupling matrices starting from the two limiting cases of zero and infinite frequencies. In the first case we prove how the geometric (toroidal) effects can be avoided recovering the generation of almost monochromatic control fields. In the second case the effects of the presence of non-uniformities in the boundary (e.g. gaps, portholes) is tackled.

Besides experimental implementation of different types of decoupling matrices, a detailed model of the system has been developed and proved to greatly help the interpretation of experimental results. The comparison of model results with experimental measurements will also be discussed.