Model based feedback control system of plasma shape in RFX-mod
Tokamak discharges

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The RFX-mod experiment (R/a = 2.0/0.46 m), originally designed to produce high current Reversed Pinch Field plasmas (plasma current up to 2 MA), is currently operated also as a low current circular low-q Tokamak (Bt ~ 0.55 T, Ip ~150 kA @ q\textsubscript{a}≈2 ). Successful MHD active control experiments maintaining stable Tokamak discharges at 1.3≤q\textsubscript{a}≤2 have been carried out through the stabilization of m=2, n=1 mode. Different algorithms, sensor and control coil configurations have been used taking advantage of the flexibility of the active MHD control system. In order to extend the significance of these studies, X-point divertor like configurations and possibly ohmic H-mode discharges are planned. In this paper the first plasma shape feedback control experiments and their progress are reported. Stable D-shaped plasma discharges were previously obtained with a feed-forward control of the Field Shaping Coil currents, exploiting the degrees of freedom provided by the poloidal field system and the power supplies. An effective feedback control system of the vertical position has been implemented by acting on the m=1, n=0 current component of the outer and inner array of saddle coils of the MHD active control system. A feedback control system of plasma ellipticity and triangularity has also been designed following a Single-Input-Single-Output approach and successfully operated to gain experience in plasma shaping. The design of a full model based Multiple-Input-Multiple-Output control of the plasma shape included the development of a new linearized plasma response model obtained by CREATE_L/CarMa0 code, the model benchmarking with experimental data and a procedure to reduce the errors in boundary reconstruction caused by the spatial aliasing in the measurements due to the Field Shaping Coil currents.