Design and implementation of the plasma control system

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The COMPASS tokamak was recommissioned in 2007 and it needed new digital controllers for its experimental research. This thesis presents the design and implementation of control of main plasma parameters such as plasma current, plasma position, plasma shape and electron density. Improved plasma current control with resetting set points suppresses overshooting and thus increases the length of the flat top phase. A method for estimating the plasma position, gain tuning for the controller and decreasing latencies and delays to obtain robust position control are presented. Lower delays improve plasma stability and decrease the frequency of disruptions. The plasma shape controller is a feedforward controller with a method to suppress oscillations which are coming from mutual inductance between power supplies controlling plasma horizontal position, plasma shape and plasma current, which all use the same coil. Averaged electron density is corrected in real-time according to the interferometer line of sight and a non-linearity of measurement. Controllers and their improvements described here, played a major role in achieving H-mode scenario and fulfilling the experimental program.

Keywords: tokamak, plasma current control, plasma position control, plasma shape control, electron density control