Magnetic Control of Tokamak Plasmas [

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Monografía

The problem of confining a plasma, with sufficiently high density and temperature, is of crucial importance if nuclear fusion is to be made usable as a form of power generation. Tokamaks \2013 devices with a toroidal geometry \2013 are among the most popular candidates by which such confinement can be achieved. A tokamak separates a plasma from its surroundings by means of a magnetic field generated by several coils distributed around the plasma. The main topic of Magnetic Control of Tokamak Plasmas is the design of feedback control systems guaranteeing the stability of plasma equilibrium inside a tokamak and the regulation of the plasma position and shape during plasma pulses. Modelling and control details are presented, allowing the non-expert to understand the control problem. Starting from equations of magneto-hydro-dynamics, all the steps needed for the derivation of plasma state-space models are enumerated. The basics of electromagnetics are frequently recalled. The control problem is then described beginning with control of current and position \2013 vertical and radial \2013 and progressing to the more challenging shape control. The solutions proposed vary from simple PIDs to more sophisticated MIMO controllers. Wherever possible, the various topics are rounded out with results obtained through the authors\2019 contributions to experiments with actual tokamaks. Mathematical details which are outside the normal province of control engineers are presented in an appendix for the interested reader. The ideas formulated in this monograph will be of great practical help to control engineers, academic researchers and graduate students working directly with problems related to the control of nuclear fusion. They will also stimulate control researchers interested more generally in the advanced applications of the discipline

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