NONLINEAR FEEDBACK CONTROL OF PLASMA IN TOKAMAK WITH COMPLICATED MAGNETIC CONFIGURATION

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Tokamaks with non-circular plasma and complicated magnetic configuration are widespread in perspective machines for controlled fusion and plasma physics researches. Among them are ASDEX-U and DIII-D, JET and JT-60U, ITER and TCV, BPX and others which have mostly elongated plasma shape and single-null or double-null divertor plasma. Plasma shape and divertor magnetic configuration are determined by the system of the toroidal currents in plasma and external poloidal coils. By means of current control in the poloidal field coils it is possible to maintain plasma shape according to a preprogrammed scenario, irrespective of changes in the plasma parameters. In order to guarantee the desired performance the high-order multivariable controller using more accurate linearized model in state-space form [1] was developed [2]. According to results [3] its performance better than the performance of a multivariate controller. In this paper for the same targets we propose the alternative approach to the plasma feedback control. Plasma current and currents in the poloidal field (P.F.) coils are considered as adjustable variables. The plant model to be controlled is the electromagnetically coupled circuits of the equivalent plasma contour and PF coils only [4]. Prescribed currents values required to provide nominal tokamak operation are calculated from instantaneous magnetic measurements and possibly other diagnostics. As a result the control system may be considered as feedback servo-system. Nonlinear control for currents stabilization wasdeveloped because of unlike linear one it allows to optimize simultaneously several contradictory criteria. For problem under consideration owing to nonlinear control it is possible to provide fast attenuation of excursion and at the same time to minimize the system response tothe bounded errors in measurements and to unmodelled effects. Servo-signals are formed by digital system, which may be a part of computerized magnetic diagnostic system. Analog-digital or pure digital controller is preferable for currents control.

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