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The application of optimal control theory to the vertical plasmas stabilization at TCV N. CRUZ, A.P. RODRIGUES, C.A.F. VARANDAS, Associacao EURATOM/IST, IPFN, IST, Portugal, J.-M. MORET, S. CODA, B.P. DUVAL, Association Euratom-Conf Suisse, CRPP, EPFL, Switzerland — From an axisymmetric circular shape plasma device, most present tokamaks have become axisymmetric elongated cross section shaped plasma devices, aiming at increasing energy confinement times. However, the elongated cross section of the plasma shape makes its vertical position unstable and a real-time feed-back control loop is necessary to stabilize it. The Tokamakà Configuration Variable (TCV) uses in-vessel poloidal field coils driven by a pair of fast switching power supplies to achieve highly elongated plasmas vertical stabilization. This contribution describes a new vertical stabilization non-linear digital controller developed for TCV, aiming at improving the performance of the power supplies and in-vessel coils stabilizing the vertical position of the plasma. From the modeling of the plasma response to the actuators, a state-space model is obtained, that is used to calculate a high order transfer function (TF) of the plasma position response to the voltage applied to the power supplies. This TF must go through a model reduction algorithm to obtain a lower-order model that may then be used to establish the bang-bang time-optimal controller. A state-space map of the controllable region and switching points is derived for the calculation of the bang-bang controller. From this map the switching-time is optimized to minimize the time to reach the set point. A description of the control algorithm development and hardware/software implementation is presented, with preliminary results of the controller.

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