OPTIMIZATION OF TRAJECTORIES IN TOKAMAK DISCHARGES BY OPTIMAL CONTROL METHODS.
– talk –

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The optimization of scenarii to achieve thermonuclear conditions has a great importance in the reseach for controlled fusion by magnetic confinement and especially for the ITER Tokamak. The idea is to optimize the external poloidal magnetic field system in order to achieve a desired trajectory (plasma current ramp-up, plateau, desired plasma boundary,..).

An evolutive model has been written, which is based on the coupling between 2D axisymmetric equations for the magnetic poloidal flux (Maxwell equations + Grad-Shafranov equilibrium equation) and a 1D resistive diffusion equation inside the plasma. Consistency between the two systems is ensured by an iterative process based on the boundary conditions of the two systems.

Sequential quadratic programming methods have been used in order to minimize a cost-function which is the sum of the quadratic difference between the desired trajectory and the simulated one and the energetic cost of the system. An adjoint state has been derived for this complicate coupled system, which enables to compute the gradient of the cost-function. Then the voltages applied to the external circuits can be computed in time in order to minimize this cost-function. The open-loop control of a certain trajectory can thus be computed by this algorithm.

References

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