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Equibrium reconstruction in Tokamaks using neural networks

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In Tokamaks the free boundary equilibrium problem is an important model used to prepare scenarios, to control the plasma in real time or in a posteriori equilibrium analysis. In this model, using an axisymmetric assumption, the magnetic field can be described by the magnetic flux which is a 2D quantity solution of the well known Grad Shafranov equation inside the plasma. The right hand side of the model describes the toroidal current density which is assumed to be zero outside the plasma. In the plasma, the toroidal current density depends on two non-linear functions p' and ff' which can be identified from experimental magnetic measurements. The plasma boundary is also an unknown of the problem.

The equilibrium reconstruction inverse problem which consists in identifying the plasma current density and determining the plasma shape and the equilibrium configuration is implemented in the code NICE [1] based on a finite element discretization. This code is used by the plasma community in particular on the WEST Tokamak.

Even if the code NICE is relatively fast to solve the equilibrium reconstruction problem, it can be usefull to have a faster tool to compute specific quantities among the large number of outputs provided by this kind of tools. Using an experimental database containing magnetic measurements and NICE simulations, sub-models of NICE can be developped using neural networks. First results will be presented with application to the Tokamak West.

REFERENCES

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