CEA/CADARACHE
DIRECTION DES SCIENCES DE LA MATIÈRE (DSM)
INSTITUT DE RECHERCHE SUR LA FUSION PAR CONFINEMENT MAGNETIQUE (IRFM)
CEA/Cadarache - 13108 St Paul-lez-Durance Cedex

PROPOSITION DE STAGE 2019-2020

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Équipe de Recherche : IRFM/service/groupe	

Niveau du stage : Master/Ingénieur
Durée du stage : 5 mois

Sujet du stage :

Title : Neural Networks and Plasma Control : Application to WEST magnetic control

Context and objectives :

Fusion energy is one of the promising solution to create a carbon neutral civilization. To achieve this goal before the end of this century, the ITER project (www.iter.org), started at Cadarache in 2005, should demonstrate in the next decades the technical feasibility of controlled fusion reactions into a facility called tokamak. To prepare ITER startup and operation, the WEST (Tungsten (W) Environment in Steady-state Tokamak) project (built from the former Tore Supra tokamak) aims at testing plasma facing components and long-duration pulse operation in fully metallic environment.

The WEST tokamak is able to create elongated magnetic configurations called X-point thank to the installation of in-vessel coils and divertor coils (in charge of exhausting the plasma energy). To deal with these new configurations, the Plasma Control System (PCS) should control the vertical instability of the plasma, shape the plasma to ease the RF heating coupling and place precisely the strike points (legs of the X-point) on the divertor targets. Despite the non-linearity of the system, the PCS uses simple linear controllers for this purpose but requiring many adjustments to reach the desired shapes during commissioning session.

Work to do by the student :

This internship proposes to study the use of neural networks and artificial intelligence algorithm to ease the setting and the control of the WEST magnetic configuration. From the free boundary plasma equilibrium code FEEQS, the trainee will train a neural network to find the poloidal currents set from geometrical description of the plasma shape. This neural network will be then tested and validated in simulation. Real-time implementation into the WEST PCS could be also be taken up.

Duration: 4-6 months

skills : Master in control engineering, fusion or equivalent
Prolongement possible thèse : Yes