

SUJET DE POST-DOC 2008

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Titre du sujet de Post-Doc : Development of an expert system for the supervision of the plasma discharges in fusion devices
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<p>Résumé du sujet :</p> <p>Tokamaks are complex devices made of many subsystems and diagnostics used to ensure the plasma performance and stability while guaranteeing the safety and the integrity of the plant equipments. Every subsystem and diagnostic must be operated simultaneously over long duration requiring an important reliability. The plasma itself is a non-linear medium which behaviour can lead to a degraded confinement regime of operation. Considering long duration plasma discharges (Tore Supra > 360s, ITER > 1000s and continuous operation for a reactor), setting up expert system allowing the management of abnormal situations is a crucial issue overtaking the scope of the present fusion devices. The identification of the default could be more of less easy:</p> <ul style="list-style-type: none">- For an actuator, it generally manifests itself by its temporary unavailability. The supervisor must be able to identify when the actuator becomes again available.- For a diagnostic, the situation is somewhat more complex because it usually comprises a set of channels or sensors whose only a small number can be unavailable. In that case one must be able to identify the channel in default and perform the calculation with a reduced number of inputs. If needed, the plasma domain of operation could be subsequently reduced in accordance with the loss of accuracy of the diagnostic.- For the plasma, an abnormal situation can manifest itself by an unwanted plasma state: large MHD activity, H-L mode transition (confinement deterioration), plasma radiation and large impurity level, etc. A set of recovery actions must be proceeded to restore the plasma original performance. <p>The supervision setup must be able to identify and classify the possible defaults. Afterward, it must select the most appropriate recovery strategy considering the default itself, the plasma conditions and the operational limits imposed any subsystems and diagnostics. This second step could be done by a supervision expert system which have to chose between 4 strategies:</p> <ol style="list-style-type: none">1. The plasma is pursued with the same scenario soliciting the other actuators or defining a set of action to restore the plasma performance.2. The plasma can be pursued in a degraded mode (term to be defined more precisely in particular; it should be related to the physic requirements).3. It is not necessary to continue the plasma (too degraded performance or no recovery strategy available). A soft stop is done.4. A disruption is predicted and cannot be avoided. The plasma can be terminated by a massive gas injection to mitigate the effects of the disruption. <p>A preliminary work will consist in identifying and classifying the potential defaults that could appear. For example a default of a heating antenna (actuator) or too much MHD activity into the plasma. For each default identified, it will be necessary to define and categorise the recovery strategy or the set of operation that must be performed. In a second step, a code, managing in Real Time the abnormal situations and applying the best adapted strategy will be implemented and tested using a plasma simulator. Then, this code will be implemented in the Tore Supra Real Time controller. The propose work will bring the selected person to interact with the responsible officer of many subsystems to get a personal overview of the Tore Supra facility. She/He will participate also in the definition and the implementation of the code first on the simulator and on Tore Supra.</p>

Compétences souhaitées : Expert System, Large physic devices
Intitulé du master préconisé :