JOINT RESEARCH DOCTORATE AND EUROPEAN DOCTORAL NETWORK ON FUSION SCIENCE AND ENGINEERING

Thesis proposal for the 2014-2016 Ph.D. cycle

1) Program where the main part of activity will be realized
   CREATE Consortium

2) Thesis title:
   Development of a software tool chain for plasma magnetic modeling and control

3) Thesis supervisor
   Gianmaria De Tommasi

4) Group/s that will be involved in the program
   Federico II

5) Thesis abstract (max 600 characters)
   This thesis is focused on the development of a software suite for plasma magnetic modeling and control. The tools suite will be based on Matlab/Simulink, and it will be aimed at automating the design of plasma current, position and shape control and also advanced MHD modes control, such as Resistive Wall Modes stabilizations. The main objectives of this thesis are:
   • to develop a multi-platform and multi-machine suite of tools for both plasma magnetic modeling and control
   • to exploits the tools for the design of plasma magnetic control systems for advanced magnetic configuration (i.e., double null, snow flake, etc.)
   • to integrate the tools for automatic code generation into the suite, in order to automatically generate the code for the real-time control systems
   • to develop advanced scenarios for the collaborating tokamaks (to be defined)

6) External collaborations (existing or to be started), which might involve the Ph.D. student (if any)
   Consorzio CREATE, Naples, Italy (existing)
   DIETI, Università degli Studi di Napoli Federico II, Naples, Italy (existing)
   EAST tokamak, Hefei, China (to be started)
   JT60-SA tokamak, Naka, Japan (to be started)

7) Preliminary list of milestones for each of the three years
   **YEAR 1**
   1.1 Definition of the requirements for the tools suite
   1.2 Development of a first prototype for the tools suite

   **YEAR 2**
   2.1 Development of the final version of the tools suite
   2.2 Design of plasma magnetic control systems for advanced magnetic configuration exploiting the tools suite
### YEAR 3

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<td>3.1</td>
<td>Design of plasma magnetic control systems for advanced magnetic configuration exploiting the tools suite</td>
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<td>3.2</td>
<td>Development of advanced scenarios for the collaborating tokamaks (to be defined)</td>
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<td>Support to plasma magnetic modeling and control for the collaborating tokamak (to be defined)</td>
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8) Description of the research project (max 8000 characters)
This thesis is focused on the development of a software suite for plasma magnetic modeling and control. The tools suite will be based on Matlab/Simulink, and it will be aimed at automating the design of plasma current, position and shape control and also advanced MHD modes control, such as Resistive Wall Modes stabilization.
The main objective is to redesign the XSC Tools which have been successfully used in the last 10 years:
• to design the eXtreme Shape Controller and the Current Limit Avoidance system for the JET tokamak.
• to support the plasma axis-symmetric modeling for different tokamaks (JET, MAST, ITER, DEMO, among the others)
The main objectives of this redesign activity is:
• to improve the multi-platform and multi-machine management
• to include an optimized and faster version of the CREAT-NL nonlinear 2D plasma magnetic equilibrium code to be used also in Simulink simulations
• to exploits the modeling tools for the design of plasma magnetic control systems for advanced magnetic configuration (i.e., double null, snow flake, etc.)
• to improve the usability of the graphical user interface
• to integrate the tools with the Remote Data Access functions of MDSplus
• to integrate the tools for automatic code generation into the suite

Relevant bibliography
