PhD in Information Technology and Electrical Engineering
Università degli Studi di Napoli Federico II

PhD Student: Federico Fiorenza

Cycle: XVIII

Training and Research Activities Report

Year: First

Tutor: prof. Gianmaria De Tommasi

Date: December 6, 2023

1. Information:

- **PhD student: Federico Fiorenza**
- **DR number: 996968**
- **Date of birth: 15/09/1999**
- **Master Science degree: Automation & Control Engineering**
- **University: University of Naples Federico II**
- **Doctoral Cycle: XVIII**
- **Scholarship type: *PNRR NEFERTARI***
- **Tutor: prof. Gianmaria De Tommasi**

2. Study and training activities:

Activity	Type[1]	Hours	Credits	Dates	Organizer	Certificate[2]
"Is control a solved problem for aerial robotic research?"	**Seminar**	**1**	**0.2**	**12/01/2023**	**Prof. Fabio Ruggiero**	**Y**
"Industry 4.0 Fundamentals in Bosch Applications"	**Seminar**	**10**	**2**	**23-26/01/2023**	**Prof. Ing. Mariagrazia Dotoli**	**Y**
Design of the ITER Plasma Control System for the PFPO-1 phase"	**Seminar**	**12**	**2.4**	**27/2/2023 – 02/03/2023**	**ITER Organization**	**N**
"Using delays for control"	**Seminar**	**1**	**0.2**	**01/03/2023**	**Prof. Adriano Mele**	**Y**
Neural Networks and Deep Learning – Theoretical Foundations	**Course**	**46**	**3**	**10/01/2023- 22/02/2023**	**Prof. Giorgio Buttazzo**	**Y**
Sistemi di intelligenza artificiale applicati al controllo dei plasmi nei tokamak	**Seminar**	**4**	**0.8**	**17-18/05/2023**	**Prof. Giuseppe Calabrò**	**Y**
The Linear Parameter Varying approach: theory and Application	**Course**	**20**	**4**	**25-29-30/05 - 01/06/2023**	**Prof. Olivier Sename**	**Y**

SIDRA 2023 PhD summer school	**Doctoral School**	**30**	**6**	**July 3 - 8, 2023**	**Prof. Maria Elena Valcher**	**Y**
"Advanced Course on Plasma Physics and Diagnostics"	**Course**	**48**	**6**	**13 - 24 March 2023**	**University of Naples-University of Padova**	**Y**
Ricerca e formazione nella società della transizione digitale	**Seminar**	**5**	**1**	**22/09/2023**	**Prof. Stefano Russo**	**N**
Participation to JT-60SA Integrated Commissioning	**Research**		**10**	**30/10/2023-1/12/2023**	**QST organization**	**Y**

1) Courses, Seminar, Doctoral School, Research, Tutorship
2) Choose: Y or N

2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1	-	-	-	-	-
Bimonth 2	**0**	**4.8**	**4**	**0**	**8.8**
Bimonth 3	**3**	**0**	**5**	**0**	**8**
Bimonth 4	**0**	**0.8**	**5**	**0**	**5.8**
Bimonth 5	**16**	**0**	**5**	**0**	**19**
Bimonth 6	**0**	**1**	**5**	**0**	**6**
Total	**19**	**6.6**	**24**	**0**	
Expected	**30 - 70**	**10 - 30**	**80 - 140**	**0 – 4.8**	

3. Research activity:

The PhD bourse is funded by the Italian National Recovery and Resilience Plan (PNRR) and the subject is devoted to the design and deployment of the RFX-mod2 plasma magnetic control. However, the research area/topic I will work on will be not limited to RFX-mod2 but will include the design of magnetic control and diagnostics for tokamak devices. Indeed, during this first year the activities are mainly aimed at broadening my knowledge in control of fusion devices. In this context I've already attended a course on Plasma physics and diagnostics held at Consorzio RFX in Padova, and I'm studying the plasma control system of RFX. Moreover, I'm also working on possible alternative techniques for the magnetic control. For instance, I've contributed to developed a new control strategy for the plasma equilibrium in superconductive tokamaks in absence of in-vessel coils, taking the JT-60SA Integrated Commissioning as a case study. Finally, I'm also studying algorithms for the plasma boundary identification suitable for real-time implementation and I am developing a plasma boundary reconstruction algorithm for the DTT tokamak.

Another research topic I'm carrying out, is the Opacity in Petri Nets. The goal is to derive necessary and sufficient conditions to assess opacity for live and bounded Petri Nets. The conditions should then be verified by means of ILP problems which offers a simple way to determine if a system satisfies the properties or not.

4. Research products:

1) ***EUROfusion internal report****: SA-SE.OP.RT.01-T003-D001 Report on the commissioning of the JT-60SA plasma equilibrium control system*
2) ***Journal paper (to be submitted)****:"Control of elongated plasmas in superconductive tokamaks in the absence of in-vessel coils", G. De Tommasi, L. E. di Grazia, S. Dubbioso, F. Fiorenza, D. Frattolillo, M. Mattei, A. Pironti*

5. Conferences and seminars attended

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6. Activity abroad:

I have participated in the JT-60SA Integrated Commissioning (IC) at the Naka Fusion Institute in Naka-shi,Ibaraki,Japan. During this period, I have supported the IC of JT-60SA by performing analysis on magnetic equilibrium reconstruction and control, and I've reported these activities during the weekly Plasma Team Meetings.

In total, I've spent one month abroad this year.

7. Tutorship

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