



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Vincenzo Paolo Loschiavo

XXIX Cycle

Training and Research Activities Report – First Year

Tutor: Prof. Ing. Raffaele Albanese

1. Information

Vincenzo Paolo Loschiavo

M.Sc. Degree in Mechanical Engineering – University of Naples Federico II

ITEE Ph.D. XXIX Cycle

Grant

Tutor: Prof. Eng. Raffaele Albanese

2. Study and Training activities

During the first ITEE Ph.D. year, I had the opportunity to attend many interesting courses with the aim to improve my previous knowledge and my skills. In particular:

- PLASMI E FUSIONE TERMONUCLEARE CONTROLLATA (PLASMAS AND CONTROLLED THERMONUCLEAR FUSION);
- MODELLI NUMERICI PER I CAMPI (NUMERICAL METHODS FOR ENGINEERS);
- EUROPROGETTAZIONE (EUROPEAN PROJECTS);
- PROJECT MANAGEMENT PER LA RICERCA (RESEARCH PROJECT MANAGEMENT).

Furthermore, I had the opportunity to attend many seminars as:

- “Opportunities and challenges in two dimensional magnetic recording”, J. Cocker, 2 April, 17:30-18:30 (DIETI)
- “Circuiti quantistici”, Prof. G. Miano, 4 April, 15:00-16:00 (DIETI)
- “Plasmon resonances and Riemann hypothesis”, Prof. Isaak Mayergoyz, 23 May, 15:00-17:00 (DIETI)
- “High-Dimensional pattern recognition via sparse representation”, Prof. Allen Yang, 4 June, 16:30-18:30 (DIETI)
- Scuola Nazionale di Dottorandi in Elettrotecnica “Ferdinando Gasparini”, Corso breve “Electromagnetic compatibility (EMC) for Engineers”, Sorrento, 18 June, 10:00 – 17:30

- Ciclo di seminari “Nano-carbon based components and materials for high frequency electronics”, Proff. Maffucci, Maksimenko, Slepyan, Lobko, 6 October, 10:00 – 14:00 (DIETI)
- “Quantum Teleportation”, Prof. G Miano, 23 October, 17:00 – 18:00 (DIETI)
- “Heterogeneities in temporal networks emerging from adaptive social interactions”, Prof. Takaaki Aoki, 14 November, 12:00-13:00 (DIETI)
- “Smoothed Particle Machine Perception: a proposed method for sensor fusion and physical-spatial perception”, Prof. Nick Hockings, 14 January, 15:00-16:00 (DIETI)
- “Mechanics of solids: from beam theory to rapid prototyping for surgery planning”, Prof. Ferdinando Auricchio, 15 January, 10:00-11:00 (DIETI)
- “Applications for software developments: types, interactions and continuous integration”, Prof. Antonio Alzamàn, 16 January, 11:00-13:00 (DIETI)
- “Risk Management meets model checking: fault tree analysis and model-based testing via games”, Dr. Marielle Stoelinga, 20 January, 10:30-12:30 (DIETI)
- “Joint location and design optimization for resource allocation in software defined virtual networks”, Proff. Antonia Tulino and Claudio Sterle, 21 January, 11:00-13:00 (DIETI)
- “State of the art in Power Converters for High Voltage DC transmission systems”, Prof. Philippe Ladoux, 28 January, 11:00-13:00 (DIETI)

Finally, I took part in different events organized by the Scuola Nazionale Dottorandi di Elettrotecnica “Ferdinando Gasparini” in which I had the opportunity to attend different lectures on the topics:

- ELECTROMAGNETIC COMPATIBILITY;
- QUANTUM MECHANICS;
- NEURAL NETWORKS.

In the table, there is a short credits recap.

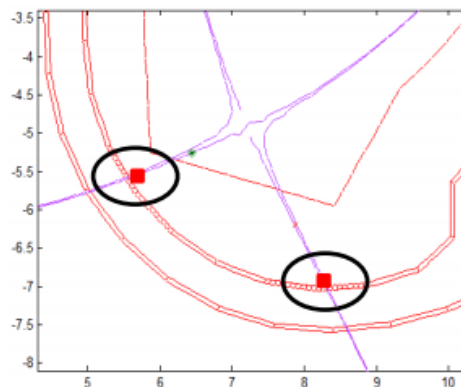
Credits year 1							
	1	2	3	4	5	6	
Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary
Modules	21		3		3	5	11
Seminars	5	0,4	0,8		1	0,2	4,4
Research	34	10	8	8	8	6	43
	60	10	8,8	11	9	9,2	58

The credits acquired by modules are less than those expected because some benefit assessment, related to lectures attended during this year (e.g. Scuola Nazionale Dottorandi di Elettrotecnica “Ferdinando Gasparini”, Ottobre 2014), will be carried out in the next months.

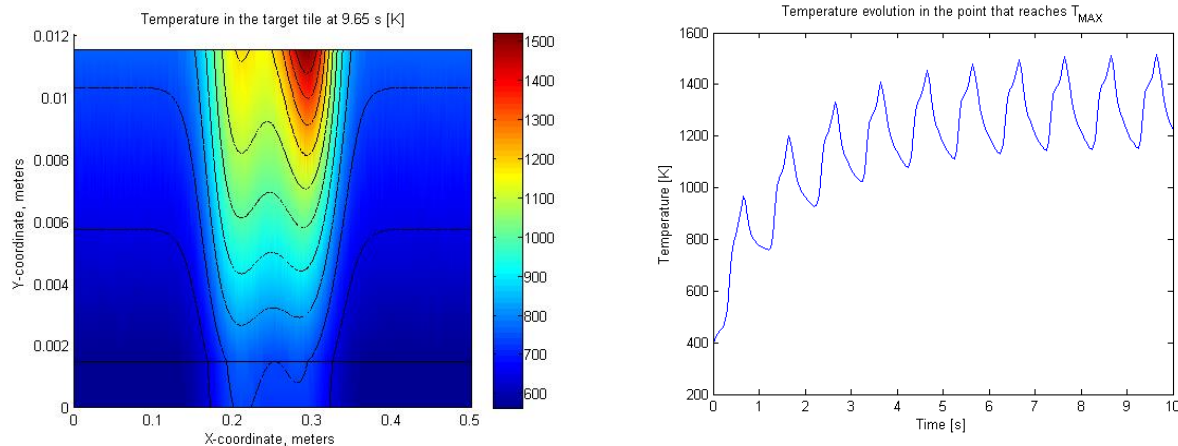
3. Research activity

The research activity proposed by my tutor - that I accepted enthusiastically - is addressing the power exhaust and particles in the next generation fusion reactors. This topic is regarded as one of the ultimate challenges for the design of DEMO reactor. In particular the aim of the activity I've carried out was to understand which one could be the better solution in the divertor target tiles design. To do that, in the first part of the year I focused on the "state-of-the-art" in addressing the power exhaust in the existing machines and more in general I've investigated most of the main divertor design aspects (thermal, mechanical and electro-magnetic).

At the end of this first phase, with the constant support of my tutor, we identified the Strike-Point Sweeping as one of the most promising techniques for spreading the huge heat load impinging on the material surfaces (PFCs – Plasma Facing Components). The strike points sweeping is a periodical movement of the strike points produced by dedicated in-vessel coils, which are connected in antiserries. These coils should be located in a position suitable to allow shielding and maintenance.



The further step was to develop a 2-D FEM model in order to study the benefits achievable with the Strike Point Sweeping technique. To do that, first I reproduced an existing 2-D model implemented for the JET tokamak. Then I realized my own 2-D Matlab model for DEMO reactor – this one has been my main contribution - and I carried out a Sensitivity Analysis of the main Strike Point Sweeping parameters (Amplitude and Frequency) to quantify the benefits in terms of material surfaces temperature and heat flux decrease.



Part of this main activity has been carried out during 18 days spent in the Max Planck Institut for Plasma Physics – EUROfusion (Garching - Munich) working with my tutor and many engineers of the CREATE research group (M. Mattei, R. Ambrosino, M. de Magistris, S. Minucci, R. Fresa). In those days, I had also the possibility to meet relevant engineers and physicists (F. Maviglia, G. Federici, R. Wenninger) working on the DEMO reactor design and those meetings resulted in helpful collaborations.

4. Products

During this year I was involved in one Workshop Paper: F. Maviglia et al, “Limitations of transient power loads on DEMO divertor and analysis of mitigation techniques”, presented at the EFPW2014, 1 - 3 December 2014, Split, Croatia.

I’m involved also in another paper – just submitted and not yet accepted - “Limitations of Fast and Slow Transient Power Loads on DEMO Divertor and Analysis of Mitigation Techniques” that will be presented at the ISFNT (International Symposium on the Fusion Nuclear Technology) in September 2015.

5. Conferences and Seminars

I attended the XXX Riunione annuale dei ricercatori in Elettrotecnica ET 2014, Sorrento, 19-20 June 2014

6. Activity abroad

I've spent 18 days (28 July – 14 August 2014) in the Max Planck Institut for Plasma Physics – EUROfusion (Garching - Munich) with my tutor and many engineers of the CREATE research group (M.Mattei, R. Ambrosino, M. de Magistris, S. Minucci, R. Fresa). In those days, I worked also with F. Maviglia, G. Federici, R. Wenninger (EUROfusion) on the DEMO reactor design. Furthermore, I got in touch with Davide Bernardi (ENEA - Brasimone) in order to carry out an activity on the thermal fatigue during the 2015.

7. Tutorship

I was involved – 10 hours - in practice exercises proposed to the students of the “Elettrotecnica” and “Introduzione ai Circuiti” courses held by professors R. Albanese and M. de Magistris.