



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Marco Maffei

XXXIV Cycle

Training and Research Activities Report – First Year

Tutor: Antonio De Maio – co-Tutor: Alfonso Farina, Augusto Aubry



1. Information

Marco Maffei

XXXIV Cycle- ITEE – Università di Napoli Federico II

No Fellowship

Advisor: A. De Maio – Co Advisors: A. Farina, A. Aubry

2. Study and Training activities

- "2018 5G International PhD School, CNIT, December 4-6, 2018, Rome, Italy." Doctoral School.
- "2019 Radar Electronic Warfare Course, Cranfield University, February 4-8, 2019, Shrivenham, UK" Doctoral School
- "L. Callegaro, "The Redefinition of the International System of Units," University of Roma Tor Vergata and IEEE AES Chapter, February 12, 2019, Rome, Italy." Seminar
- "A. Lazzareschi Sergiusti, ""On the Design of Complex Systems: from Operational Requirements to Technical Specifications," University of Roma Tor Vergata and IEEE AES Chapter, February 12, 2019, Rome, Italy. Seminar
- "E. Silva, "Applied Superconductivity in Italy" University of Roma TRE, April 8, 2019, Rome, Italy" Seminar
- "G. Galati, "An Historical perspective of Radar Design and Development in Italy," CESMA and IEEE AES Chapter, April 9, 2019, Rome, Italy." Seminar
- A. Farina, "Seminar on Cognitive Radar," Leonardo Company, May 9, 2019 Seminar
- "2019 IEEE-SPS/EURASIP Summer School on "Network and Data-driven Learning Fundamentals and Applications", May 20-24, 2019, Lecce, Italy." Doctoral School
- 3rd GTTI Workshop on Radar and Remote Sensing, 30-31 May 2019. Workshop.
- 2019 IEEE International Workshop on Metrology for Aerospace, June 19-21, Torino, Italy. Workshop
- "S. Barbarossa, "Topological Signal Processing," University of Roma Tor Vergata and IEEE AES Chapter, July 2, 2019, Rome, Italy." Seminar
- "Workshop on Mathematical Models for Science and Engineering, University of Napoli Federico II, September 11-13, Napoli, Italy." Workshop



Student: Name Surname
marco.maffe2@unina.it
 Tutor: Name Surname
ademaio@unina.it
 Cycle XXXIV

	Credits year 1						Credits year 2						Credits year 3						Total	Check	
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6			
Modules	18	1	1	2	1	6	9					0	0					0	0	6	30-70
Seminars	13		2	2	1	6	6					0	0					0	0	6	10-30
Research	34					0	42					0	0					0	0	0	80-140
	65					12	57					0	0					0	0	12	180

Year	Lecture/Activity	Type	Credits	Certification	Notes
1	"2018 5G International PhD School, CNIT, December 4-6, 2018, Rome, Italy."	Doctoral School	4,8	x	Credits Formula has been defined as 0.2 x # days x # hoursperday
1	"2019 Radar Electronic Warfare Course, Cranfield University, February 4-8, 2019, Shrivenham, UK"	Doctoral School	8	x	
1	"L. Callegaro, "The Redefinition of the International System of Units,"	Seminar	0,6	x	
1	University of Roma Tor Vergata and IEEE AES Chapter, February 12, 2019, Rome, Italy."	Seminar	0,6	x	
1	"A. Lazzareschi Sergusti, "On the Design of Complex Systems: from Operational Requirements to Technical Specifications,"	Seminar	0,6	x	
1	University of Roma Tor Vergata and IEEE AES Chapter, February 12, 2019, Rome, Italy.	Seminar	0,6	x	
1	"E. Silva, "Applied Superconductivity in Italy" University of Roma TRE, April 8, 2019, Rome, Italy"	Seminar	1,6	x	
1	"G. Galati, "An Historical perspective of Radar Design and Development in Italy," CESMA and IEEE AES Chapter, April 9, 2019, Rome, Italy."	Seminar	0,6	x	
1	A. Farina, "Seminar on Cognitive Radar," Leonardo Company, May 9, 2019	Seminar	0,6	x	
1	"2019 IEEE-SPS/EURASIP Summer School on "Network and Data-driven Learning Fundamentals and Applications", May 20-24, 2019, Lecce, Italy."	Doctoral School	8	x	
1	3 rd GTTI Workshop on Radar and Remote Sensing, 30-31 May 2019	Workshop	3,2	x	
1	2019 IEEE International Workshop on Metrology for Aerospace, June 19-21, Torino, Italy.	Workshop	4,8	x	
1	"S. Barbarossa, "Topological Signal Processing," University of Roma Tor Vergata and IEEE AES Chapter, July 2, 2019, Rome, Italy."	Seminar	0,6	x	
1	"Workshop on Mathematical Models for Science and Engineering, University of Napoli Federico II, September 11-13, Napoli, Italy."	Workshop	4,8	x	
			38,2		





3. Research activity

- a. Title: Bayesian Inference via Spaceborne Radars for Space Situational Awareness
- b. Problem: How can we support governmental strategies to acquire a "...capability to watch for objects and natural phenomena that could harm satellites in orbit.
- c. Idea: Despite increasing demands for augmenting space-based monitoring capabilities for near-Earth SSA, there is no evidence of operative Spaceborne Radars (SBR) for debris detection and tracking. In the absence of SBR experimental data, one may certainly conjecture on the design of a novel cognitive-based payload transceiver with specific benefits for SSA with respect to ground based assets inference capabilities.
- d. Methodology: *Gedankenexperiment* to nurture SSA data fusion systems with novel spaceborne signatures estimations (via analysis and simulation) (no breadboarding).
- e. Developments:
 - 1) Providing a harmonizing ontological framework for the possible environmental scenario to cope with. The objective of such an ontology is strictly related to the conceptual modeling of both channel and target phenomenologies, thus paving the way for reasonable a priori formulations needed by Multi Target Tracking (MTT) Bayesian paradigms.
 - 2) Outlining possible SBR payloads archetypes, beyond current Synthetic Aperture Radar (SAR) imaging purposes, as tailored to the general tasks of debris detection and parameter estimation pertaining to air-to-air Real Aperture Radars (RAR) taking into account legacy pulse Doppler radar systems.
 - 3) Harmonizing radar frameworks for target detection and tracking in terms of both multi-target and cognitive perspectives, following the work by Dr. K. Bell (et al.). Considering the limits of Poisson Point Processes (PPP) for hyper-velocity multi-target densities tracking via iFilters, and possibly adopting techniques from stochastic geometry, following the work by Dr. R. Streit (et al.), Dr. R. Mahler (et al.), Dr. A. Farina (et al.), Dr. B.-T. Vo and Dr. B.-N. Vo et al.) and machine learning following the work by Dr. S. Haykin (et al.)

4. Products

- M. Maffei, A. Aubry, A. De Maio, A. Farina, "Bayesian Inference via Spaceborne Radars for Space Situational Awareness," Dissertation Draft (Chapters 1-2-3 complete)(Chapters 4-5-6 In Fieri).
- M. Maffei, A. Aubry, A. De Maio, A. Farina, "On the Exploitability of the Ka Band for Spaceborne Radar Debris Detection and Tracking Measurements," 2019 IEEE International Workshop on Metrology for Aerospace, Torino, Italy, June 2019.
- M. Maffei, A. Aubry, A. De Maio, A. Farina, "On the Exploitability of the Ka Band for Spaceborne Radar Debris Detection and Tracking," Poster for Workshop on Mathematical Models for Science and Engineering, University of Napoli Federico II, September 11-13, Napoli, Italy.
- M. Maffei, A. Aubry, A. De Maio, A. Farina, "An Ontology for Spaceborne Radar Debris Detection and Tracking," submitted to the IEEE AESS Magazine.

Training and Research Activities Report – First Year

PhD in Information Technology and Electrical Engineering – XXIX Cycle

Marco Maffei

5. Conferences and Seminars

- 2019 IEEE International Workshop on Metrology for Aerospace, Torino, Italy, June 2019. Presentation 1 paper
- Workshop on Mathematical Models for Science and Engineering, University of Napoli Federico II, September 11-13, Napoli, Italy. Poster 1 paper

6. Activity abroad

None

7. Tutorship

A Course Syllabus has been prepared - Novel Spaceborne Radars Archetypes in the Space Economy - draft July 2019.