# Sapienza PhD in ICT

Doctoral program in Information and Communications Technologies at Sapienza Università di Roma, Rome, Italy

# First Year Doctoral Program Form

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| **LAST NAME** | **Milani** |
| **NAME** | **Luca** |
| **CURRICULUM** | **Radar and Remote Sensing** |
| **DOCTORAL CYCLE** | **XXXII** |

The Doctoral Program Form contains, year by year, the description of the PhD program of each Doctoral student. This form must be submitted to the PhD coordinator with roughly the following timing:

- by the end of February of the first year for first year students
- before the admission to the second year by perspective second year students
- before the admission to the third year by perspective third year students

The Doctoral Program Proposal is approved by the PhD board shortly after submission. The Doctoral Program requirements place formalized emphasis on methodology and mastery of fundamental and applied engineering systems concepts. A Doctoral Program Proposal should be constructed in agreement with the Faculty mentor, that is the supervisor or tutor, by complying to the requirements, described in the Tables below.

**ADVANCED COURSES: 12 CREDIT FORMATION UNITS (CFU)[1]**
Only courses/schools providing a final verification test with pass/fail outcome certified by instructor can be included here.

| Title | Type | Duration / period | CFU[2] | Motivation for selection |
|---|---|---|---|---|
| Earth Observation Data Analysis | Master Degree course | 48 teaching hours + 72 homework-study hours / II semester | 6 | The course fits my interests and my research topic. It is ideal for improving and completing my knowledge in the field of Earth Observation. The course aims at providing a general background on the remote sensing systems for Earth Observation from space-borne platforms and on data processing techniques. It describes, using a system approach, the characteristics of the system to be specified to fulfil the final user requirements in different domains of application. The course also provides an overview of the most important applications and bio-geophysical parameters (of atmosphere, ocean and land), which can be retrieved. The most important techniques for data processing and product generation are analysed together with an overview of the main Earth Observation satellite missions and the products they provide to the final user. |
| Project Management | PhD Course | 24 teaching hours June 19-20-21, 2017 | 6 | The course will focus on the international Project Management tool "PRINCE2® Foundation" and will lead to the acquisition of an international certification, forming an invaluable added feature and skill to your formation.<br>The course is mandatory and a final exam is scheduled in order to obtain the international certificate. |
| **Total CFU** | | | 12 | |

[1] Please insert lines as required/appropriate, and for each line complete each column of the Table.
[2] Indicate here the CFUs that can be accounted for as a result of the successful completion of the activity; for Master Degree courses, assume 1 CFU = 8 teaching hours + 12 homework/study hours, for a total of 20 hours. This rule can be slightly adjusted for other types of courses/activities (e.g., PhD courses may require slightly less hours per CFU)

| SEMINARS AND LABORATORY ACTIVITIES: 6 CFU[3] | | | | |
|---|---|---|---|---|
| **Activity** | **Type** | **Duration / period** | **CFU[4]** | **Motivation for selection** |
| Elementi di comunicazione tecnico-scientifica | Master Degree course | 8 teaching hours + 12 homework-study hours / II semester | 1 | The course provides the fundamental elements of the technical-scientific writing and interpersonal communication, tools that the graduates in scientific and technological disciplines in any sector use to disseminate data, facts, opinions, recommendations to the colleagues and the professional community where they will be involved. |
| The Ladybird Guide to Spacecraft Communications (Book Two) | ESA training course | 12 teaching hours 14-March-2017 - 6-April-2017 8 chapters, one seminar for each chapter | 3 | The course deals with the problem of communicating with your spacecraft over vast distances and changing geometries with low power transmitters and receivers.<br>The course is suitable for young engineers who want to quickly acquire exposure to a broad spectrum of operationally important disciplines.<br>Chapter 1: The challenge. Characteristics of spacecraft transmitters and receivers<br>Chapter 2: Modulation<br>Chapter 3: De-modulation<br>Chapter 4: Coding<br>Chapter 5: Decoding<br>Chapter 6: Protocols<br>Chapter 7: Link Budgets: Transmission and Travel<br>Chapter 8: Link Budgets: Reception |
| Multispectral Satellite Application Topics Course | COMET MetEd course by UCAR and NOAA's NWS | 8 teaching hours Online | 2 | This self-paced distance learning course provides forecasters, students, researchers, and other interested learners with a foundation in the products and applications from multispectral satellite observations and various methodologies used to derive multispectral image products.<br>The four core modules that comprise this course are:<br>• Creating Meteorological Products from Satellite Data<br>• Multispectral Satellite Applications: RGB Products Explained<br>• Imaging with VIIRS: A Convergence of Technologies and Experience, 2nd Edition<br>• Multispectral Satellite Applications: Monitoring the Wildland Fire Cycle |
| **Total CFU** | | | 6 | |

| ADDITIONAL INDEPENDENT FORMATION AND RESEARCH ACTIVITIES: 6 CFU[5]<br>Indicate activities that extend and complement the mandatory activities listed above | | | | |
|---|---|---|---|---|
| **Activity** | **Type** | **Duration / period** | **CFU[6]** | **Motivation for selection** |
| LARGE SCALE RADIO PROPAGATION | European school of antennas 2017 | 30 teaching hours UCL, Louvain-la-Neuve, June 12-16, 2017 | 7.5 | The course on Large Scale Radio Propagation will be held at the Institute of Information and Communication Technologies, Electronics and Applied Mathematics (ICTEAM), Université catholique de Louvain in the framework of the European School of Antennas 2017 and COST CA15104 IRACON. The course will cover propagation aspects for cellular and vehicular communication. Starting with the basics of propagation, modern methods used in cellular network planning as well as aspects relevant for future 5G networks, e. g. MIMO, multi-link aspects, localisation, car2X and railway communication, are taught. |
| **Total CFU** | | | 7.5 | |

[3] Please insert lines as required/appropriate, and for each line complete each column of the Table.
[4] Indicate here the CFUs that can be accounted for as a result of the successful completion of the activity; as a rule of thumb, assume 1 CFU = 20 working hours.
[5] Please insert lines as required/appropriate, and for each line complete each column of the Table.
[6] Indicate here the CFUs that can be accounted for as a result of the successful completion of the activity; as a rule of thumb, assume 1 CFU = 20 working hours.

| RESEARCH ACTIVITY: 36 CFU | |
|---|---|
| **Research area** | Earth observation, remote sensing, radiopropagation, telecommunications |
| **Research topic** | Remote Sensing of Fire and Volcanic hotspots exploiting Satellite multisource data: forward modeling, global scale spatio-temporal detection and retrieval development<br>• The research project is aimed at developing an **integrated remote sensing technique**, based on the coupling of numerical electromagnetic models with satellite-based observations<br>• **Generic hotspot detection system**, exploiting geostationary visible-infrared radiometric measurements in synergy with complementary Low-Earth orbit spectrometers.<br>• The detection system is then applied to **fire** and **volcanic hotspots** that present clear spectral signatures in the medium and thermal infrared regions, respectively.<br>• Furthermore, a **retrieval** application associated to the detected hotspots has been considered. Both visible-infrared and microwave observations may represent useful means in retrieving the **emitted radiant energy** released during biomass combustion episodes as well as observing the **ash clouds**.<br>• Both hotspot detection algorithm and retrieval modeling shall be **globally** applicable. |
| **Framework of the proposed research topic** | First step and initial planned activities for investigating the research topic and pursuing the research goals<br>• The core of the system is an **anomaly detection algorithm** identifying significant deviations from the expected brightness temperatures in a certain pixel assumed to be in accordance with the local diurnal cycles measured in the preceding weeks and propagated by a **Kalman Filter**. The algorithm is used to identify in a certain pixel the presence of cloud cover or **fire**.<br>• A **near real-time** detection system must be able to provide a valid output within the time between two timeslot of the considered instrument.<br>• For **worldwide application**, the exploitation of proper **high-performance computing** services has been considered, able to capture, curate, manage, and process "**big data**" within a tolerable elapsed time.<br>• Application of the **Microwave Integrated Retrieval System** (MIRS developed by **NOAA STAR**) to a recent volcanic eruption. Extension and development of **retrievals of associated quantities** to be embedded in MIRS. |
| **Research environment** | • Part of the activities will contribute in the framework of the **ESA PROBA-V MEP TPS.** The project intends to support the exploitation of PROBA-V data by research institutes and service companies.<br>• Active collaboration with **Progressive Systems S.r.l.** providing scientific support for operational projects and services.<br>• Collaboration with **ESA-RSS** service (Research and Service Support, ESRIN). The service will provide tools and services that can help the EO user in exploiting large amount of data, developing applications and using high-performance toolboxes.<br>• Collaboration with **NOAA STAR** in the "Microwave Integrated Retrieval System" framework.<br>• Possible collaborations with **ESA-ESOC** (European Space Operations Centre) for ground-based microwave radiometry and 5G Outdoor-Indoor Radio Propagation studies. |

| FACULTY MENTOR (TUTOR OR SUPERVISOR) | |
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| **Prof. Dr.** | Frank Silvio Marzano |
| Supervisor signature for approval | |

Signature of Doctoral student

(Luca Milani)

Date

07/04/2017