



**PhD in Information Technology and Electrical Engineering**

**Università degli Studi di Napoli Federico II**

**PhD Student: Antonio Mazza**

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**XXXIII Cycle**

**Training and Research Activities Report – Third Year**

**Tutor: Giuseppe Scarpa**



# Training and Research Activities Report – Third Year

PhD in Information Technology and Electrical Engineering – XXXIII Cycle

Antonio Mazza

## 1. Information

Antonio Mazza, Master Degree in Telecommunication Engineering – University of Naples “Federico II”

XXXIII Cycle - ITEE - University of Naples “Federico II”

Tutor: Prof. Giuseppe Scarpa

## 2. Study and Training activities

During my second year of the Ph.D I have attended the following courses:

- ❑ Professional Skills In Clinical Environment For Biomedical Engineering (2 CFU)

and the following seminars:

- Computational Biology: Large scale data analysis to understand the molecular bases of human diseases
- How to get published with IEEE

In the following table is depicted a summary of the activities presented above:

Student: Antonio Mazza antonio.mazza@unina.it		Tutor: Giuseppe Scarpa giuseppe.scarpa@unina.it		Cycle XXXIII																																
	Credits year 1									Credits year 2									Credits year 3									Total	Check							
	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	7 bimonth	8 bimonth	9 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	7 bimonth	8 bimonth	9 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth			5 bimonth	6 bimonth	7 bimonth	8 bimonth	9 bimonth	Summary	
<b>Modules</b>	20	0	0	6	0	3	9	18	10	0	0	7	0	0	0	0	0	0	0	0	0	7	10	0	0	0	0	0	0	0	0	0	2	2	27	30-70
<b>Seminars</b>	5	0.8	0	1.3	0	2.4	1.1	5.6	5	0.2	0	0.8	0	3.6	1.2	5.8	2	0	0.2	0	0	0	0	0	0	0	0	0.3	0.5	11.9	10-30	10-30				
<b>Research</b>	35	9.2	10	2.7	10	4.6	3	39.5	45	9.8	10	2.2	10	6.4	8.8	47.2	48	10	9.8	10	10	10	10	10	10	10	10	7.7	57.5	144.2	80-140	80-140				
	60	10	10	10	10	10	13.1	63.1	60	10	10	10	10	10	10	10	60	60	10	10	10	10	10	10	10	10	10	10	10	60	183.1	180				

## 3. Research activity

In the third year of my Ph.D I focused the research activity on:

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- a. Vegetation monitoring via Deep Learning approaches in Remote Sensing Applications:
  - i. Forest/Non-forest mapping using TanDEM-X products
  - ii. Forest Change detection
- b. Cloud mapping:
  - i. Using Sentinel-2 bands
  - ii. Resorting to a Landsat 8 dataset with a reliable cloud mask
- c. SAR despeckling
  - i. Study on the chain process to obtain SLC images from Sentinel-1 raw product
  - ii. Study on the impact of the dataset and on the training procedure of a CNN for the despeckling tasks
  - iii. Study on an optical guided despeckling with a non-local CNN.

Here I briefly explain each of which:

- a. Forests play an important role for the Earth's ecosystem, reducing the concentration of carbon dioxide in the atmosphere and regulating global warming. To assess the impact of forest on the ecosystems, the study of deforestation and development of global forest coverage and biomass is necessary. Remote sensing represents a very useful tool for a regular monitoring at a global scale of vegetated areas.  
The research aims to develop Deep Learning approaches in order to fuse different kind of data as to find complex relationships that are not easy to model.
  - i. In a first phase the research was focused on fusion of TANDEM-X SAR images and related features, like the interferometric correlation, for the purpose of land cover classification using convolutional neural networks.
  - ii. Ongoing research is now focused on the use of the quantity above in order to detect deforestation activities in the Amazon rainforest.
- b. The twin Sentinel-2 satellites from the Copernicus mission of the ESA provide a global World coverage with short revisit time. They also provide a multi-resolution stack composed of 13 spectral bands, between the visible and short-wave infrared (SWIR), distributed over three resolution levels. But, optical

sensors are affected by the cloud presence that can affect the information of the ground.

The research aims to develop Deep Learning approach in order to use all the Sentinel-2 bands in order to produce a 10-m spatial resolution cloud mask. Due the lack of a reliable cloud mask to make a supervised training, a domain adaptation from Landsat-8 dataset with a reliable cloud mask is performed.

- c. SAR sensors provides images in all weather and light condition differently from optical sensor, but they are affected by the speckle that affect the image. The despeckling task aims to remove this noise trying to:
  - i. Preserve the underlying signal without performing oversmoothing
  - ii. Do not introduce artifacts.

The research aims to develop Deep Learning approach in order to perform the SAR despeckling, but, for this problem a clean reference is not available, so first of all it is conducted a study to the impact of the choice of the dataset comparing the case of the use of synthetic dataset with a real reference, but the speckle is synthesized using a theoretical model; on the other hand, as clean reference is used a multilook obtained as the temporal mean of different acquisitions.

Moreover, the research activity is focusing also on a Deep Learning approach in order to use an optical guide to perform the despeckling.

#### 4. Products

##### a. Publications:

- [1] A. Mazza, G. Scarpa, L. Verdoliva, G. Poggi “Impact of training set design in CNN-based SAR image despeckling”, *IGARSS 2021 - 2021 IEEE International Geoscience and Remote Sensing Symposium*, Bruxelles, 2021 (Accepted)
- [2] A. Mazza, P. Sepe, G. Poggi, G. Scarpa “Cloud segmentation of Sentinel-2 images using Convolutional Neural Network with domain adaptation”, *IGARSS 2021 - 2021 IEEE International Geoscience and Remote Sensing Symposium*, Bruxelles, 2021 (Accepted)

## 5. Conferences and Seminars

I will attend the following conference/seminar:

- a. International Geoscience and Remote Sensing Symposium '21 (two oral presentation)

## 6. Activity abroad

I have spent two months abroad at DLR, Munich, Germany from January to February 2020.

## 7. Tutorship

Co-tutor of three Master Degree thesis student.

Supporting students in laboratory activities during Image Processing for Computer Vision course