



UNIVERSITÀ DEGLI STUDI DI NAPOLI  
FEDERICO II

itee<sup>PhD</sup>  
information technology  
electrical engineering



# PhD Student: Michele Delli Veneri

## 1-st Year Presentation

Tutor: Prof. Vincenzo Moscato

co-Tutor: Prof Giuseppe Longo

Cycle: 35th

Year: First

# My background

- MSc degree in **Physics** from University of Naples Federico II
- Research group: Pattern analysis and Intelligent Computation in mUltimedia Systems (**PICUS**), Data Mining & Exploration (**DAME**)
- PhD start date: 01/11/2019
- Scholarship type: funded scholarship
- Partner company: EUSTEMA s.p.a

# Research field of interest

- **Hybrid Classification Algorithms:** in collaboration with EUSTEMA s.p.a, I have developed a hybrid algorithm that combines **clustering** and **classification** to improve classification results. Hybrid algorithms are based on the intuition that clustering can capture interrelation between data that can be used as constraints for a classification task;
- **Compressed Sensing and Signal Analysis through DL in Astronomical Imaging:** the application of DL methods to Signal Analysis and Compressed Sensing in the astronomical images produced by large collaboration such as TOLIMAN, ALMA, SKA and ngVLA. These instruments produce data in the Big Data regime, and thus need methodologies capable of handling the speed, volume and accuracy required by the objectives of these collaborations.

# Summary of study activities

- **MSc Courses:** Hardware and Software Infrastructures for Big Data and Data Management and Computer Networks to fill the knowledge gap coming from my background;
- **Ad hoc Phd Courses and Seminars:** Machine Learning, Large Scale Training of Deep Neural Networks, SPACE Signal Processing and Computational Image formation, Linear Regression in Pytorch and Convolutional Neural Networks, Multi-GPU Training;
- **Personal Development:** Strategic Orientation for STEM Research & Writing, How to Get Published with IEE, Matlab Fundamentals.
- **Future Msc Courses:** Information Theory and Signal Elaboration by Prof. Tulino.

# Research activity: Overview



- Hybrid Models and Semi-Supervised Learning
  - In the Big Data era, the amount of information to be processed is overwhelming and, concerning ML problems, dataset labels are insufficient to cover the parameter space;
- Objective
  - Develop a **Semi-supervised self-labeling method** in order to solve many shortcomings of most approaches discussed in literature, i.e. i) *lack of sufficient initial labelled data* and ii) *inability to deal with non-spherical datasets*;
- Intended contribution (in perspective)
  - In close collaboration with EUSTEMA, I'm going to build on the hybrid **HyCASTLE** model and use its strong points to create a semi-supervised self-labelling method. We plan to apply both methods to industrial and scientific problems.

# Research activity: Overview

- **Signal Analysis and Compressed Sensing in Astronomical Imaging through Deep Learning**
  - The new generation of astrophysical instruments (TOLIMAN, ALMA, SKA) will handle multi-TBs (PB in the case of SKA) of data per day. Classical Statistical Methods fail to handle the volume and velocity of this data;
- **Objective**
  - Develop DL methods able to match the accuracies obtainable with classical statistical methods (background subtraction, detection of point-like and extended sources, denoising, segmentation, classification and weak signal detection).
- **Intended contribution (in perspective)**
  - In close collaboration with the teams that produce the data and with the supervision of Prof. Moscato and Prof. Longo respectively for the architectural solutions and the data and methodological know-how's, I plan to develop and fine tune DL-based methods capable to cope with these data volumes, velocities and needed accuracies.



ESO ALMA Support Centre  
Internal ALMA Development Study Proposal

**Bayesian Adaptive Interferometric Image Reconstruction Methods**

# Products

Delli Veneri, Michele; Picariello, Antonio; Cavuoti, Stefano; Brescia, Massimo; Sperli, Giancarlo; Moscato, Vincenzo; Abruzzese, Roberto; Longo, Giuseppe; (2020). *HyCASTLE: a Hybrid Classification System based on Typicality, Labels and Entropy*. Submitted to Knowledge Based Systems, Elsevier.

[J]

Delli Veneri, Michele; Desdoigts, Louis; Schmitz, Morgan A.; Krone-Martins, Alberto; Ishida, Emille E. O.; Tuthill, Peter; de Souza, Rafael S.; Scalzo, Richard; Brescia, Massimo; Longo, Giuseppe; Picariello, Antonio; (2020). *Periodic Astrometric Signal Recovery through Convolutional Autoencoders*. To appear in the peer review Volume "Intelligent Astrophysics" of the series "Emergence, Complexity and Computation", Book eds. I. Zelinka, D. Baron, M. Brescia, Springer Nature Switzerland, ISSN: 2194-7287, e-print arXiv:2006.13905.

Carlo Donadio, Massimo Brescia, Alessia Riccardo, Giuseppe Angora, Michele Delli Veneri, Giuseppe Riccio; (2020). *New perspective analysis to classify Earth and extraterrestrial drainage networks by Deep Learning*. Submitted and Accepted to Springer Nature.



# 42.

Life is paradoxically coincidental to the  
ironical tyranny applicable to the unparalleled  
definition of reverse entropy.

**THANK YOU FOR  
YOUR KIND  
ATTENTION**