UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

itee PhD information technology electrical engineering

DIETI. UNINA

Giovanni Giacco

Artificial Intelligence in Earth Observation applications

Tutor: Carlo Sansone

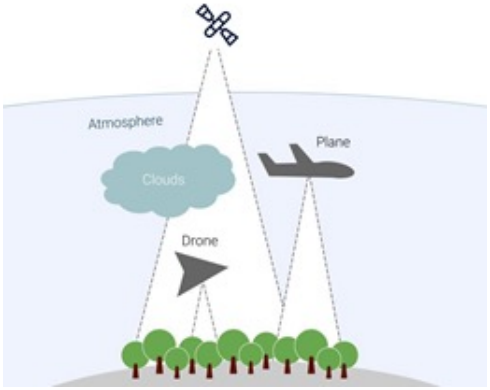
Cycle: XXXVI Year: Second

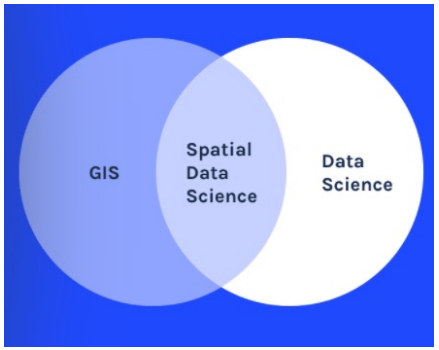
itee PhD information technology electrical engineering

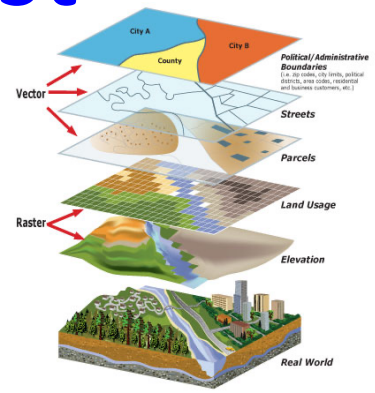
My background

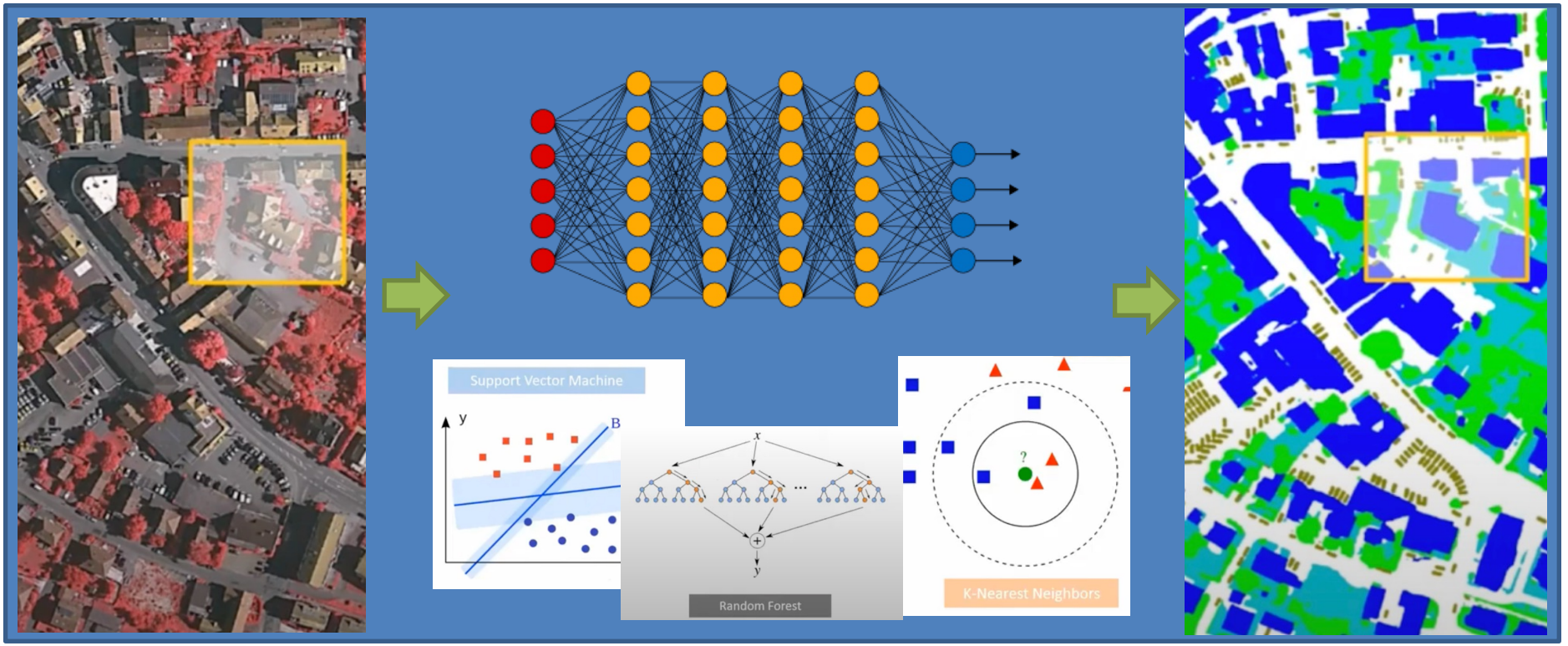
- **Master Degree:** *Computer Engineering* at University of Naples Federico II
  - Thesis: "*Deep Learning for Land Cover classification using Multispectral Sentinel-2 Satellite Imagery*"
- **Research laboratory**
  - PATTERN ANALYSIS AND INTELLIGENT COMPUTATION FOR MULTIMEDIA SYSTEMS (PICUS LAB)
- **PhD start date**: 01/11/2020
- **Scholarship type**: no scholarship
- Currently working for LATITUDO 40® (no company funded scholarship)

Research field of interest









Summary of study activities

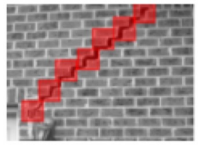
- Ad hoc PhD courses / schools
  - *How to Boost your PhD* - Dr. Antigone Marino, CNR-ISASI Dipartimento di Fisica, Unina
  - *Big Data Architecture and Analytics* - Proff. Giancarlo Sperlì, Giovanni Improta, Jari Haukka, Peter van Ooijen
  - *Imprenditorialità accademica* - P. Rippa Direttore StartCup Campania 2022 "Mario Raffa"
- Seminars
- Others
  - *Sustainable land management and Earth Critical Zone (ECZ): a journey from ECZ characterization, modelling and Geospatial Decision Support Systems – Winter School organized by the Department of Agriculture, Unina*

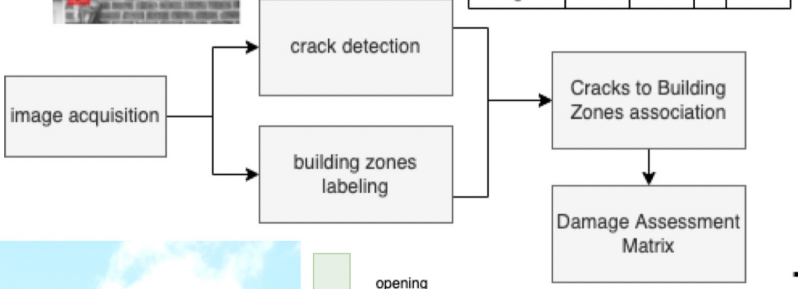
Research activity: Overview(1/3)

Problem:

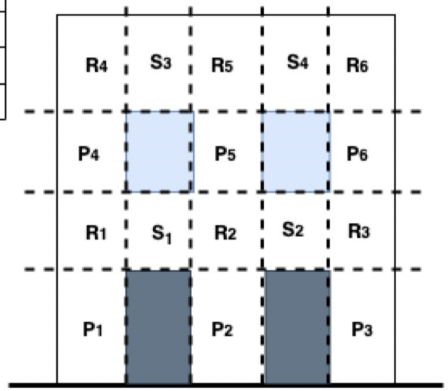
Cracks **localization** and ***characterization*** on buildings surface to automatically assess post-earthquake damages by using drone imagery

Proposed approach*:

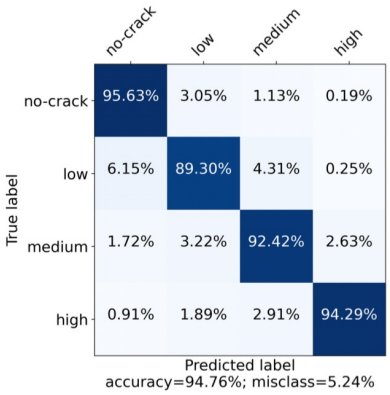




	P_1	P_2	...	AreaN
low	1	0	...	0
moderate	0	1	...	1
high	0	2	...	0



	Piers	Spandrels	Rigid Zones
low	0	0	0
moderate	2	1	3
high	10	7	12



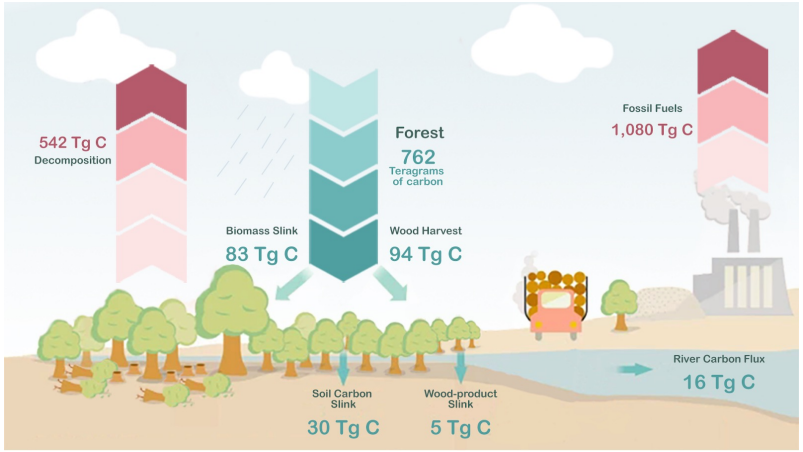
Network	Accuracy	F1
VGG16	87.0%	81.8%
DenseNet121	91.1%	86.5%
ResNet34	94.7%	89.5%
ResNet50	89.9%	84.6%

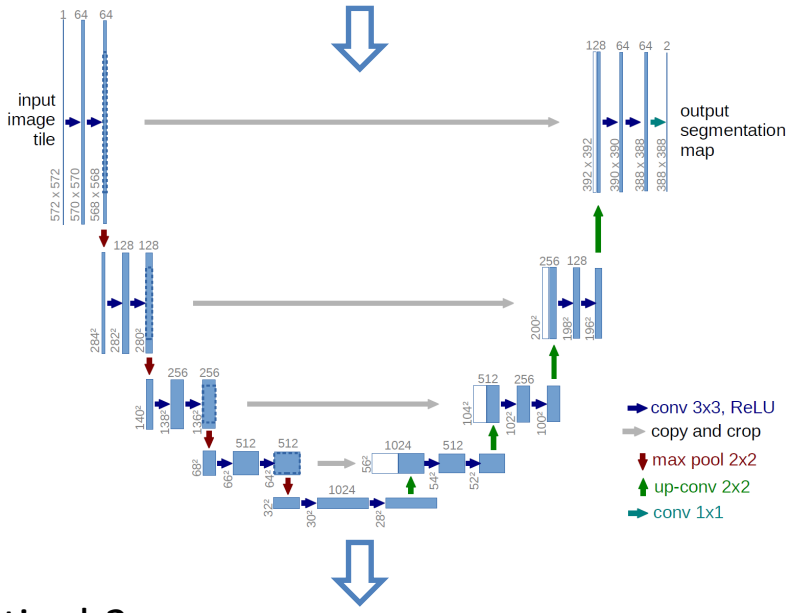
** Work in collaboration with the **Department of Structures for Engineering and Architecture (DiSt)** at Unina*

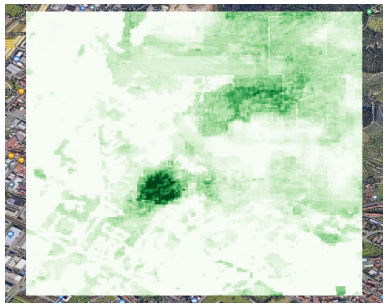
Research activity: Overview(2/3)

Problem:

Carbon Sequestration estimation without field measurement







Objective:

- Carbon Sequestration estimation using multispectral satellite images

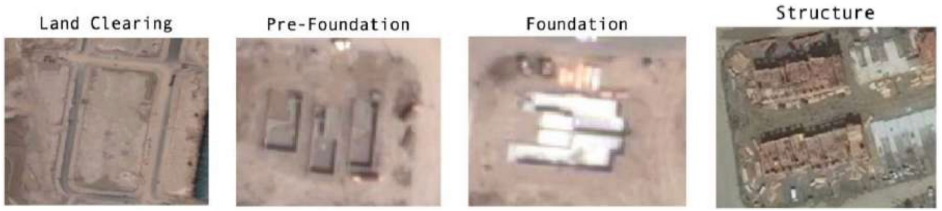
Proposed approach:

- Above Ground Biomass (AGB) estimation from Sentinel-2 satellite imagery with a pixel-wise regression U-Net
- Derive Carbon Sequestration value from AGB

Research activity: Overview(3/3)

Problem*:

- Monitoring building construction stages with free-of-charge satellite images to reduce operational costs

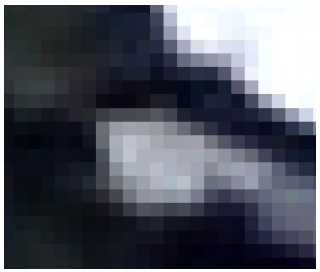


Challenge:

Aerial image

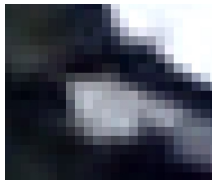
Sentinel-2 satellite

Sentinel-2 super-resolved 4X Zoom



Proposed approach:

Super-Resolution with Generative Adversial Network (**GAN**)



Stage Classification with Convolutional neural Network **(CNN)**

- Land Clearing
- Pre-Foundation
- Foundation
- Structure

** Work in collaboration with **Statistics Canada**, Canada's national statistical agency*

Products

1. Giovanni Giacco, Giulio Mariniello, Stefano Marrone, Domenico Asprone and Carlo Sansone, **Toward a system for Post-Earthquake Safety Evaluation of Masonry Buildings**, International Conference on Image Analysis and Processing (ICIAP 2021), Lecce, May 23-27, 2021; https://doi.org/10.1007/978-3-031-06430-2_26
2. Giovanni Giacco, Stefano Marrone,Giuliano Langella and Carlo Sansone , **ReFuse: Generating Imperviousness Maps from Multi-Spectral Sentinel-2 Satellite Imagery**, Future Internet 2022, 14(10), 278; https://doi.org/10.3390/fi14100278
3. Luca Battisti, Giovanni Giacco, Massimiliano Moraca, Giacomo Pettenati, Egidio Dansero, Federica Larcher, **Prioritizing the Implementation of Nature-based Solutions in an Urban Context: the Case-study of Turin (Italy).** Submitted at Cities: The International Journal of Urban Policy and Planning

Papers in preparation:

- Giacco Giovanni, Antonio Elia Pascarella, Stefano Marrone, Carlo Sansone; «ReUse: REgressive Unet for carbon Storage Estimation»
- Giacco Giovanni, Mattia Rigiroli, Stefano Marrone, Carlo Sansone; «Monitoring building construction stages with free-of-charge super-resolved satellite images»

Dissemination:

- **AI/ML & satellite imagery to achieve city-level carbon neutrality.** 2h workshop prepared for Latitudo 40 for the event **Amazon re:MARS 2022** in Las Vegas, Nevada**.** One of the only two Italian company selected.
- Presenting a Demo on *Using AI techniques to estimate how much CO2 plants can absorb at* ***Innovation Village 2022****, Città della Scienza, Naples.*

Next Year

Objectives

- Extending Carbon Sequestration estimation study using *multi-temporal* satellite imagery
- Extending the study on the Post-earthquake building damage assessment from drone imagery characterizing cracks with parameters such as height, width, and length through semantic segmentation with Convolutional Neural Networks (CNNs)
- Research on the use of super-resolution with Generative Adversarial Networks to estimate several parameters, e.g., land cover, tree cover density, land surface temperature, etc., with free-of-charge satellite imagery to obtain maps at higher spatial resolution.
- Validation of the proposed approach through the use of the output data for the analysis of several phenomena, e.g., urban heat islands, in different case studies for some Italian and European cities.

Projects

- Estimation of the amount of C02 sequestered along the entire Italian highway network. Project in collaboration with *Movyon*, part of the Autostrade per l'Italia group

THANK YOU

FOR YOUR ATTENTION