EX UMBRA IN SOLEM

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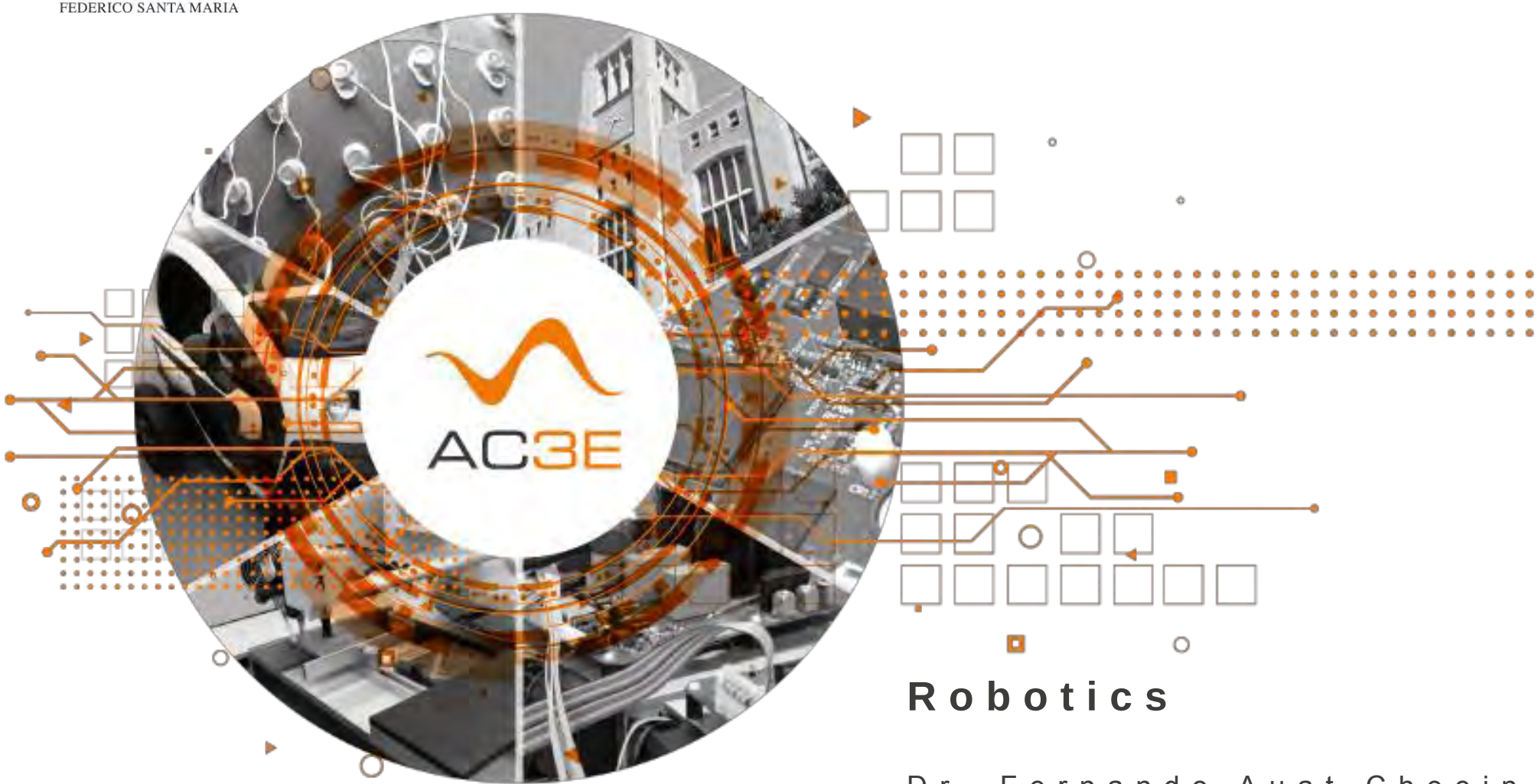
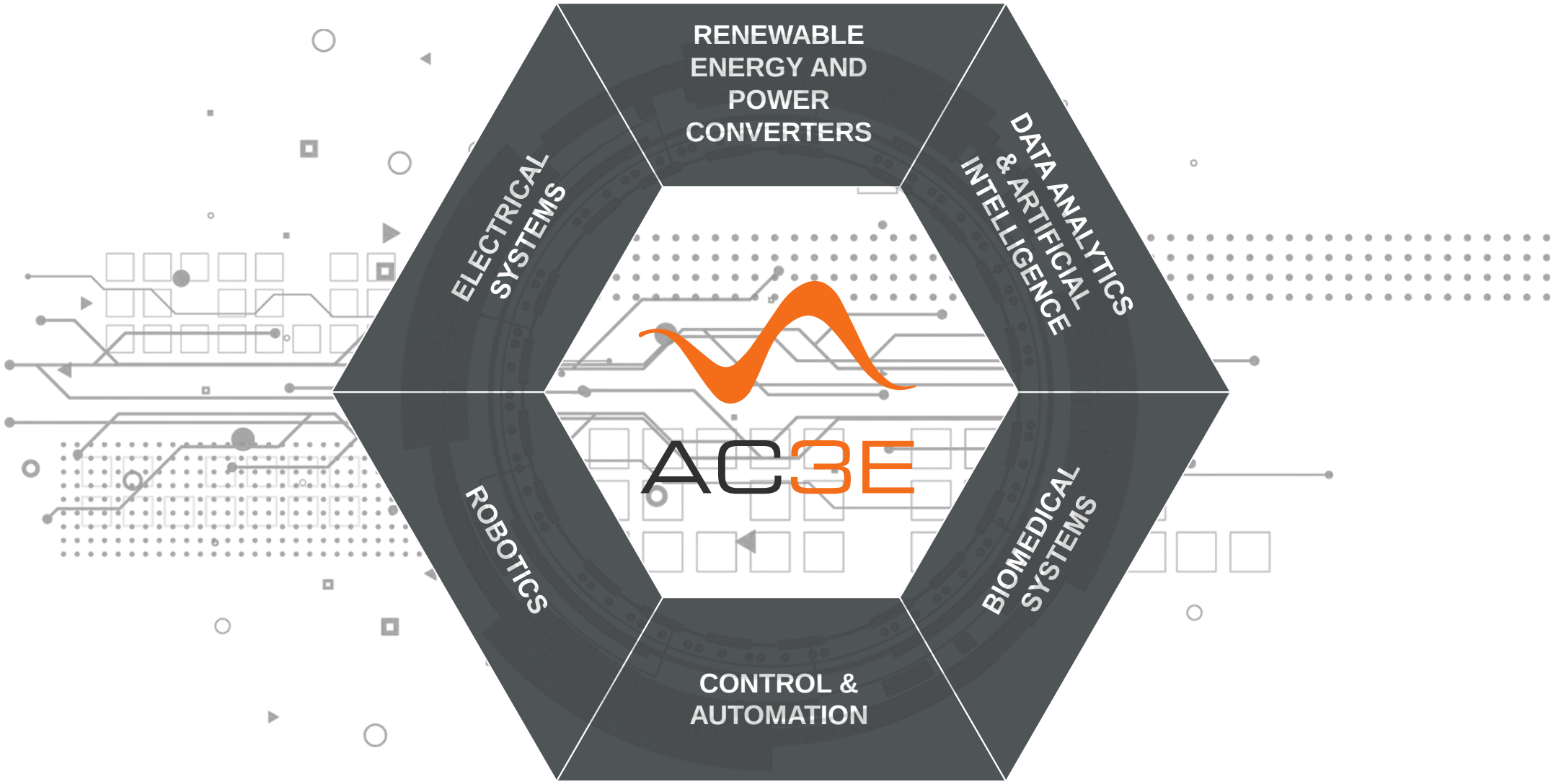
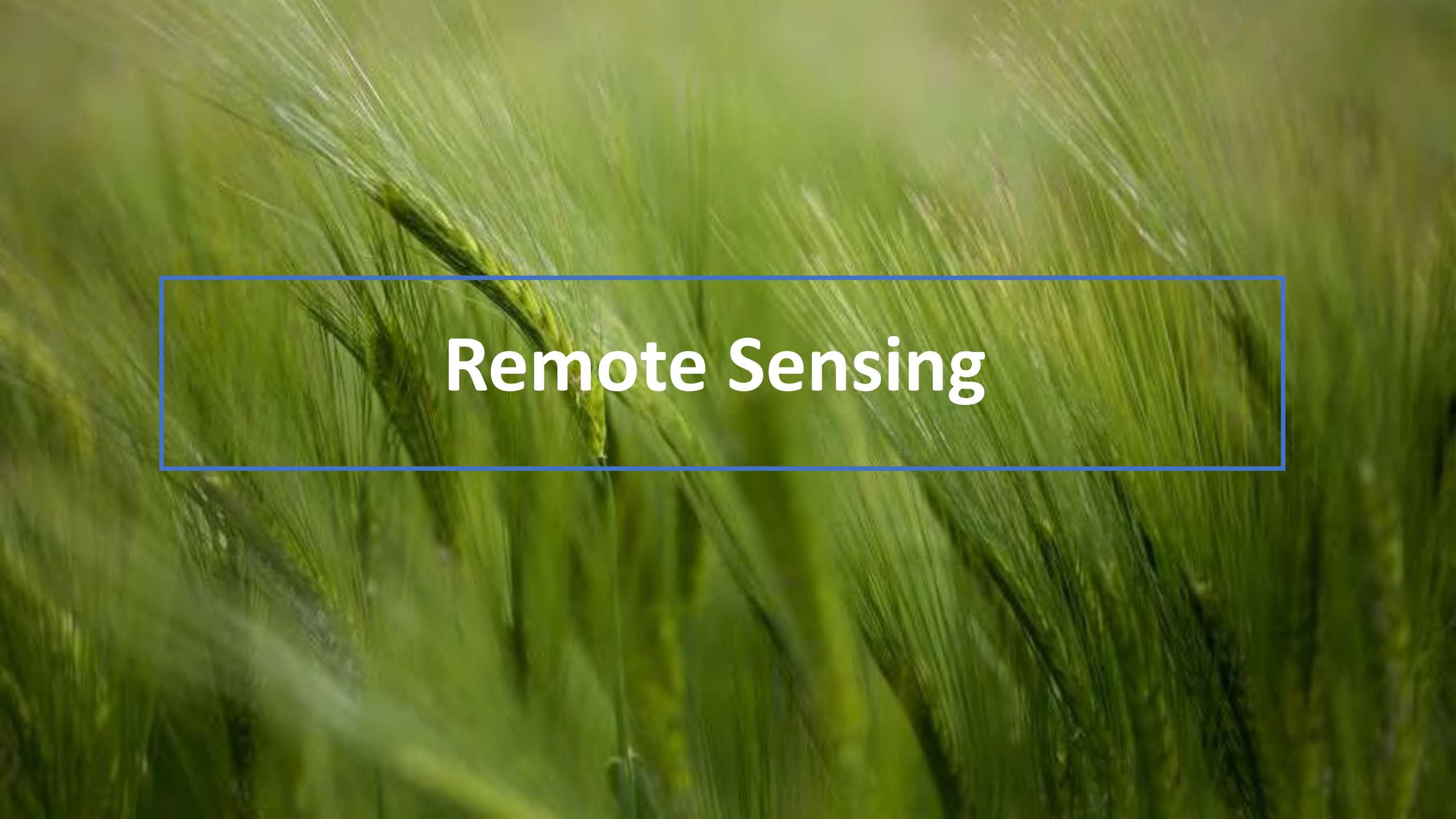


Robotics

Dr. Fernando Auat Cheein
Full Professor, UTFSM
Investigador Titular AC3E
Titular línea Robótica
fernando.auat@usm.com

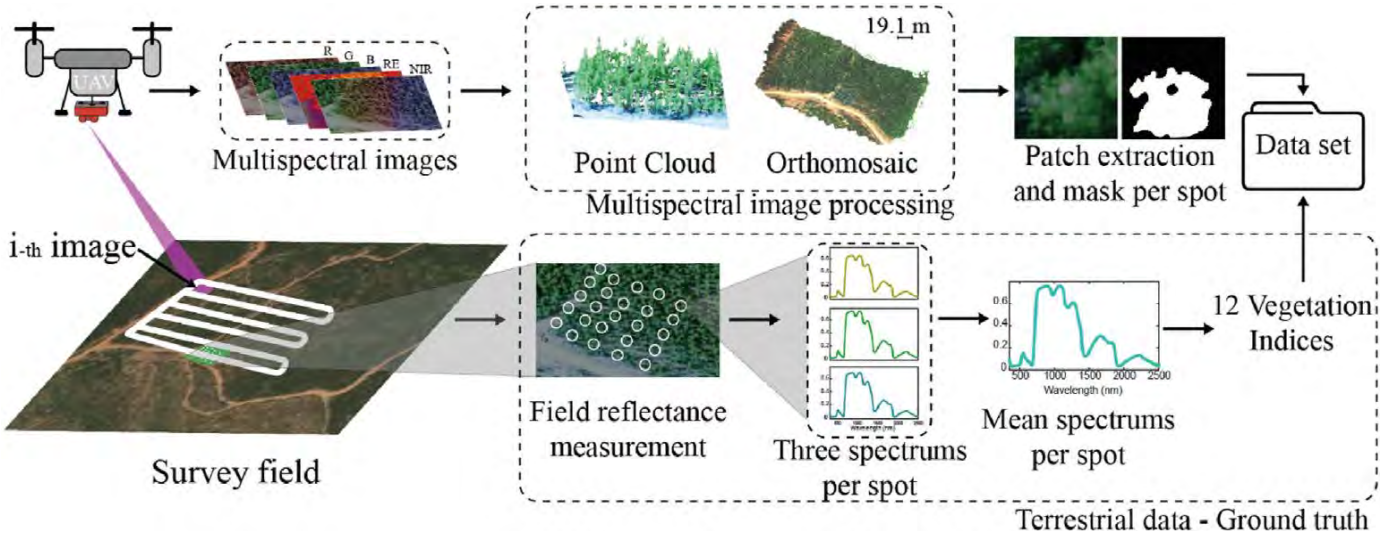
WHO WE ARE

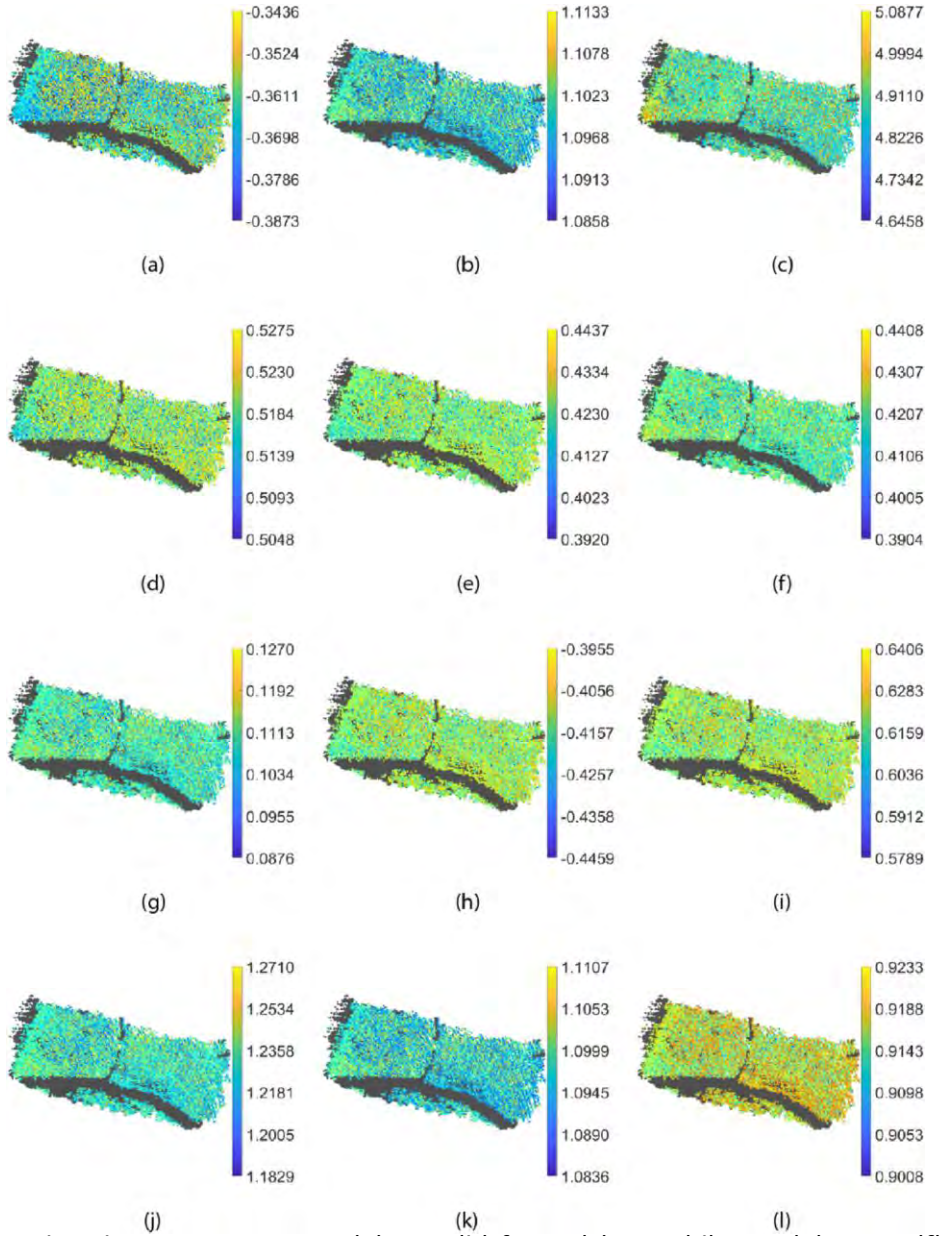

RENEWABLE ENERGY AND POWER CONVERTERS
DATA ANALYTICS & ARTIFICIAL INTELLIGENCE
BIOMEDICAL SYSTEMS
CONTROL & AUTOMATION
ROBOTICS
ELECTRICAL SYSTEMS
AC3E


Remote Sensing

Construction of 3D maps of vegetation indices retrieved from UAV multispectral imagery in forested areas

- 3D map building (using Lidar and artificial vision systems)
- Image processing (multispectral, hyperspectral and RGB)
- Use of UAV for remote monitoring and data adquisition
- Monitoring of vegetation indices
- **TRL: 3->4**

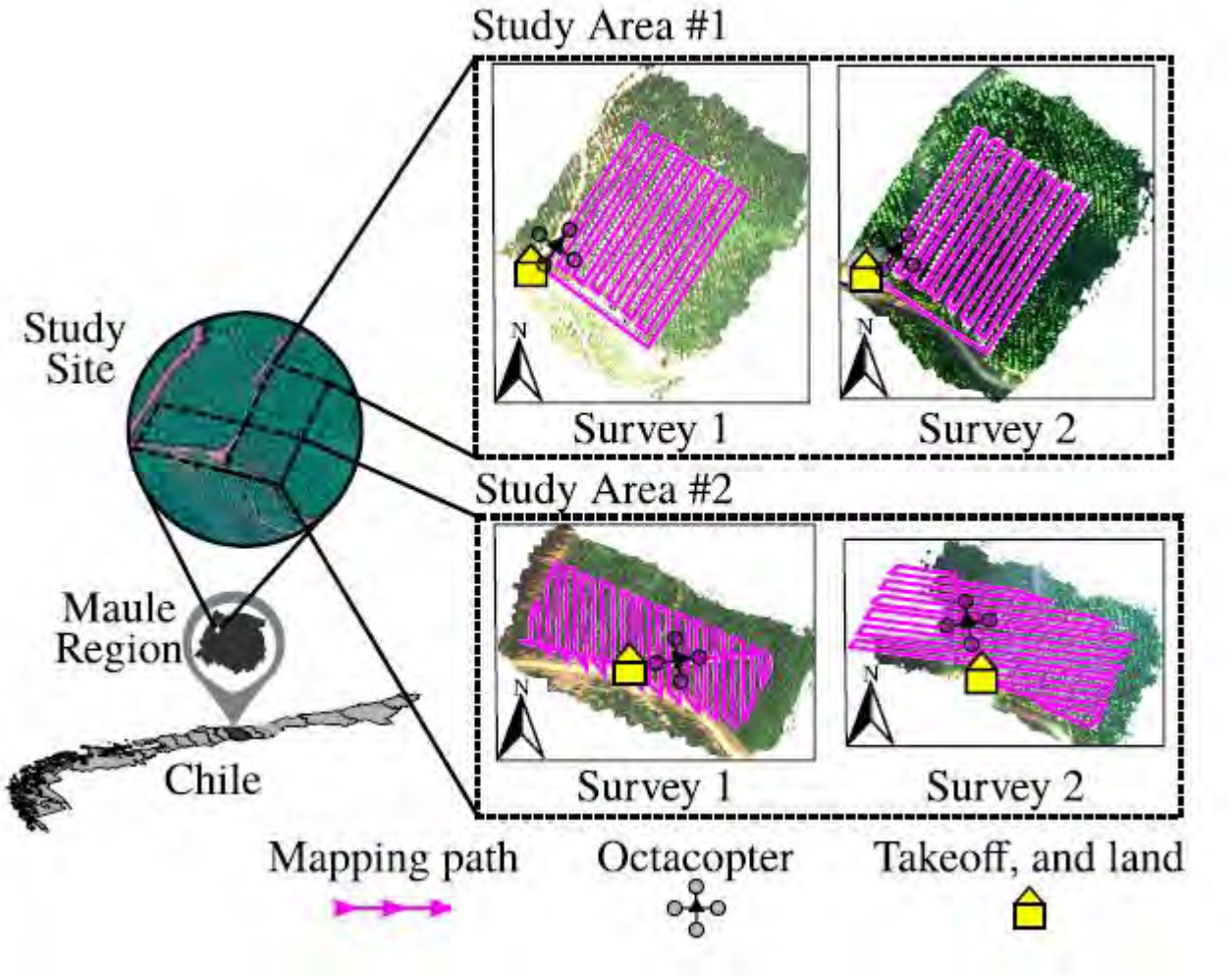


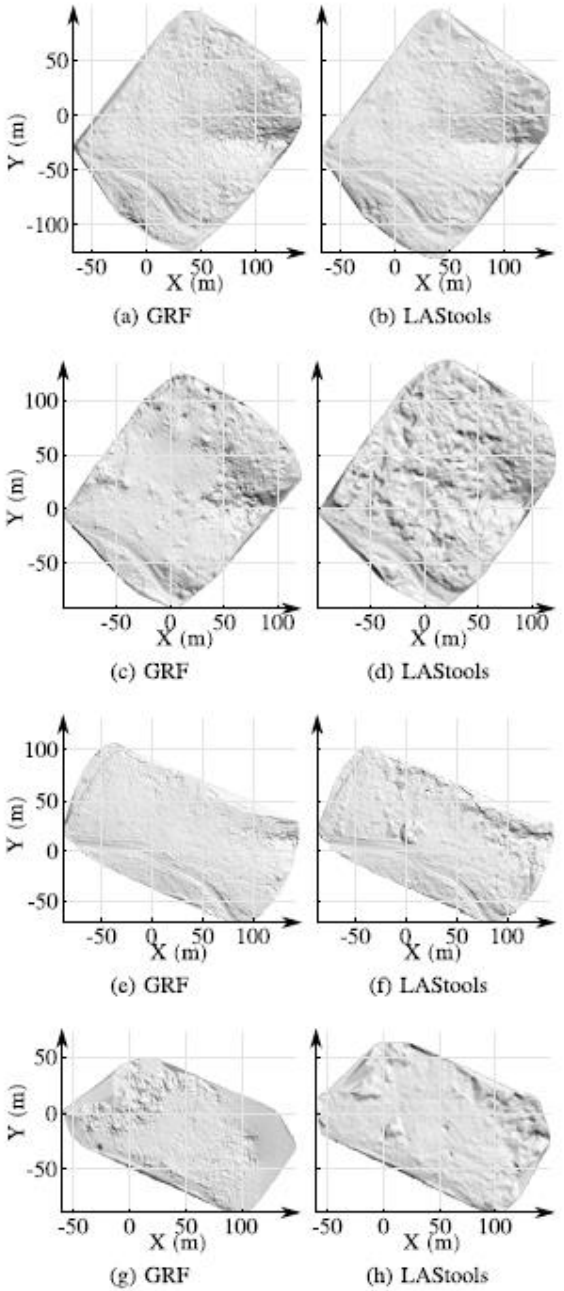


Qualitative results of the vegetation indices maps related to water content: (a) DDI, (b) fWBI, (c) LWI, (d) MSI, (e) MSI2, (f) NDII, (g) NDWI1, (h) SIWSI, (i) SRWI1, (j) SRWI2, (k) WI and (l) WBI. The grey points depict non-canopy points.

Assessment of Multispectral Vegetation Features for Digital Terrain Modeling in Forested Regions

- Vegetation features extraction
- Terrain modelling
- Vision systems and artificial intelligence techniques (Machine Learning)
- Modelling of forested regions using UAV
- **TRL 3 -> 4**





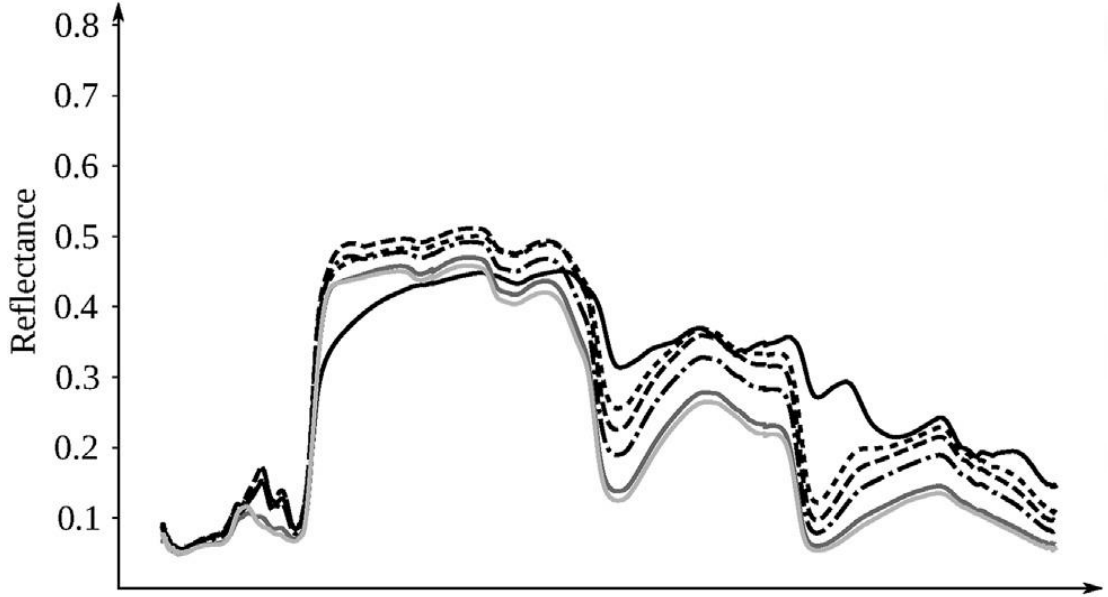
Retrieval of Vegetation Indices Related to Leaf Water Content from a Single Index: A Case Study of Eucalyptus globulus (Labill.) and Pinus radiata (D. Don.)

Single bands leaf reflectance prediction based on fuel moisture content for forestry applications

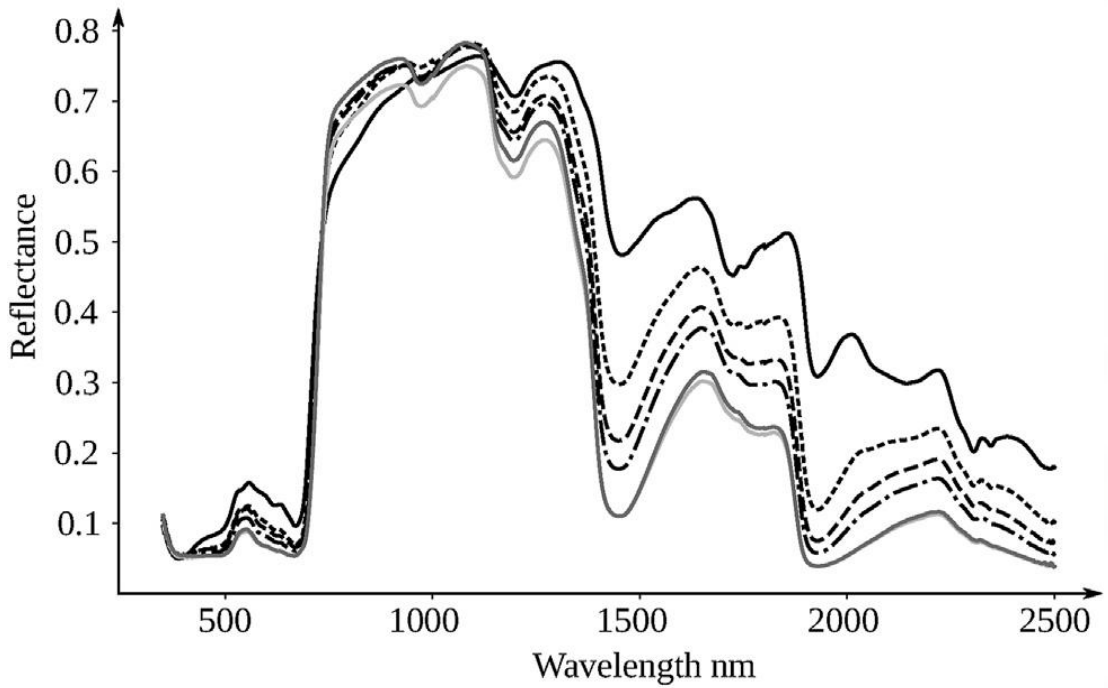
- Image processing
- Dedicated vision systems
- Water monitoring
- **TRL 4 -> 5**

(a) *Pinus radiata* samples

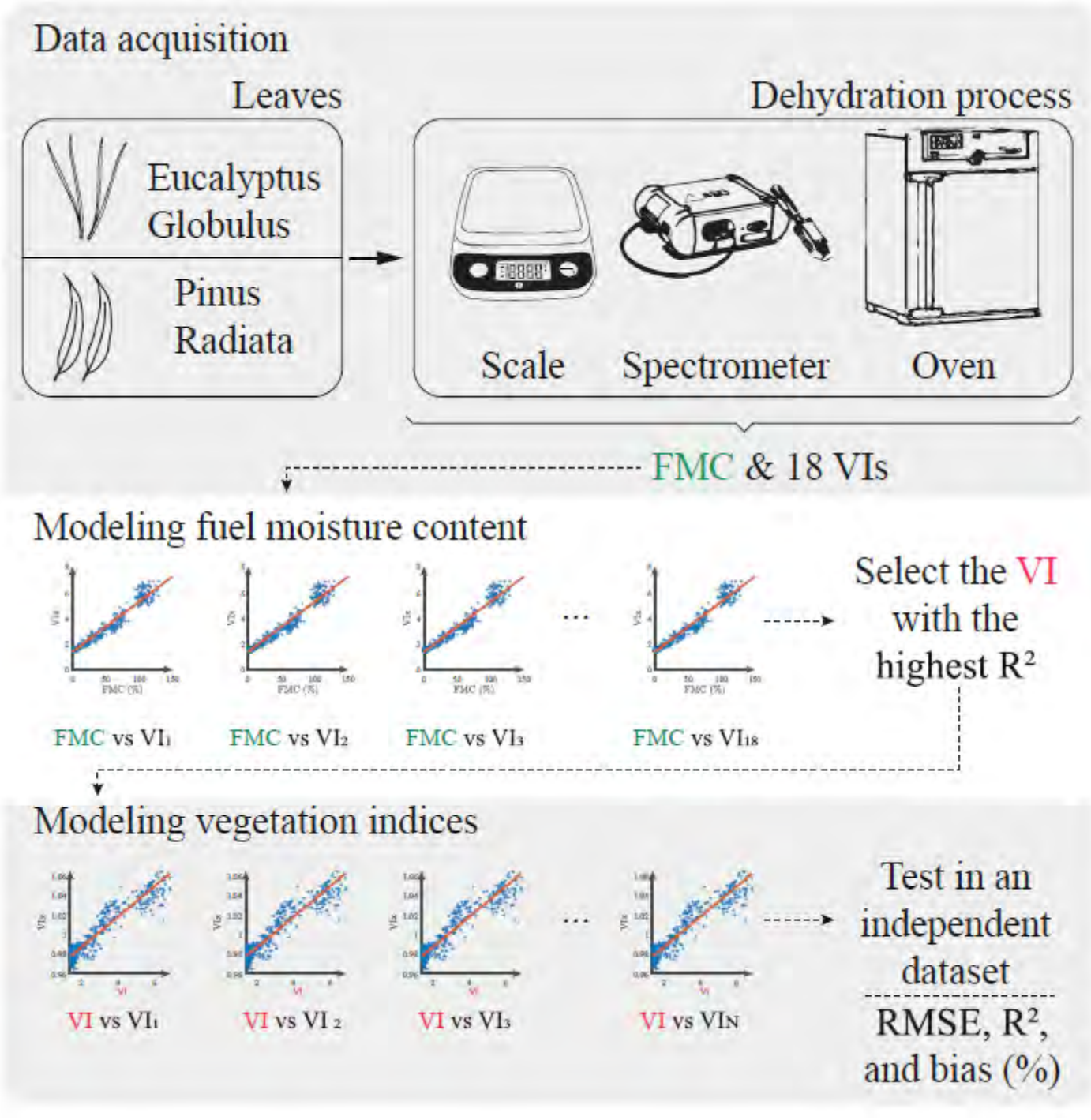
(b) *Eucalyptus globulus* samples



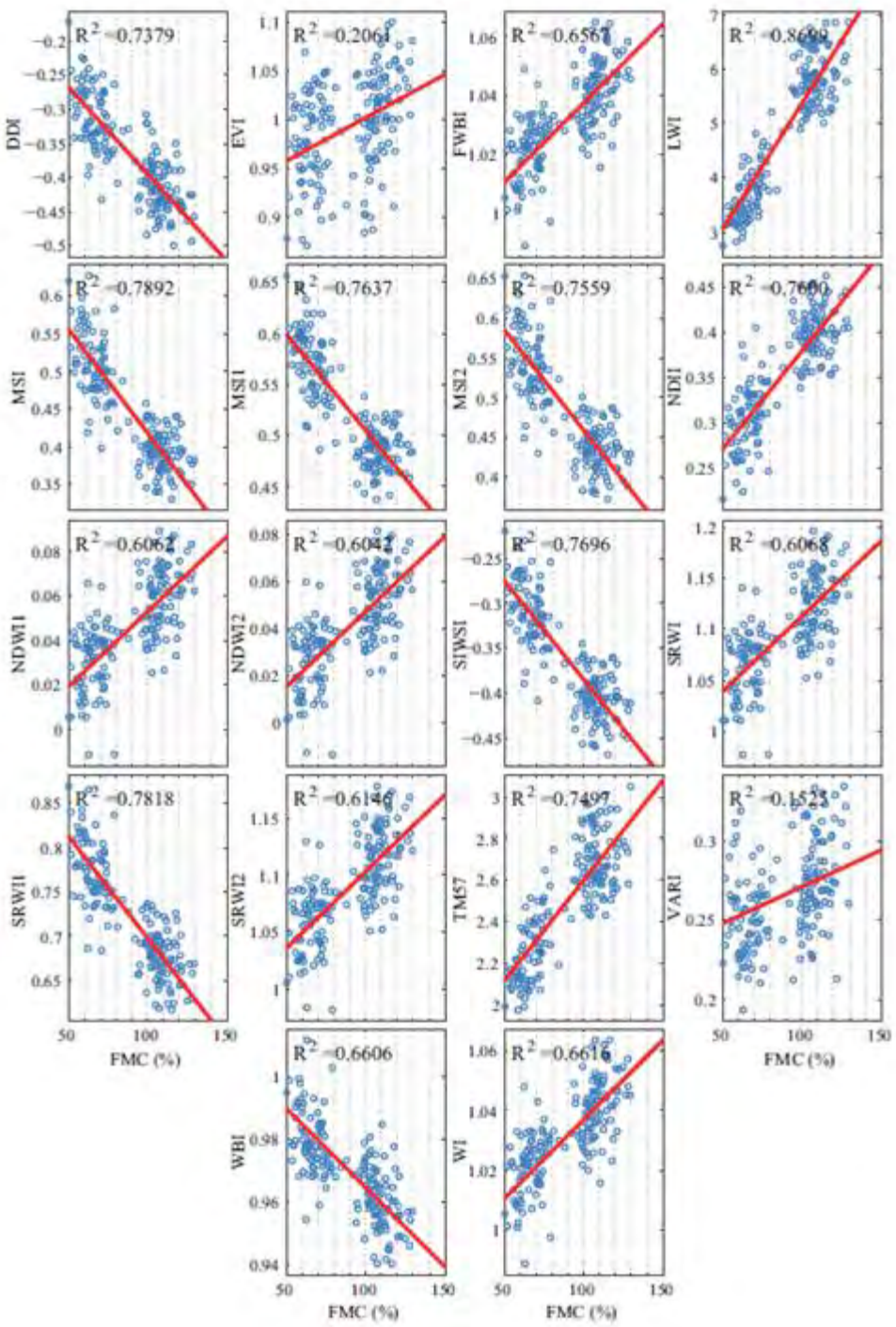
(a) *Pinus radiata*

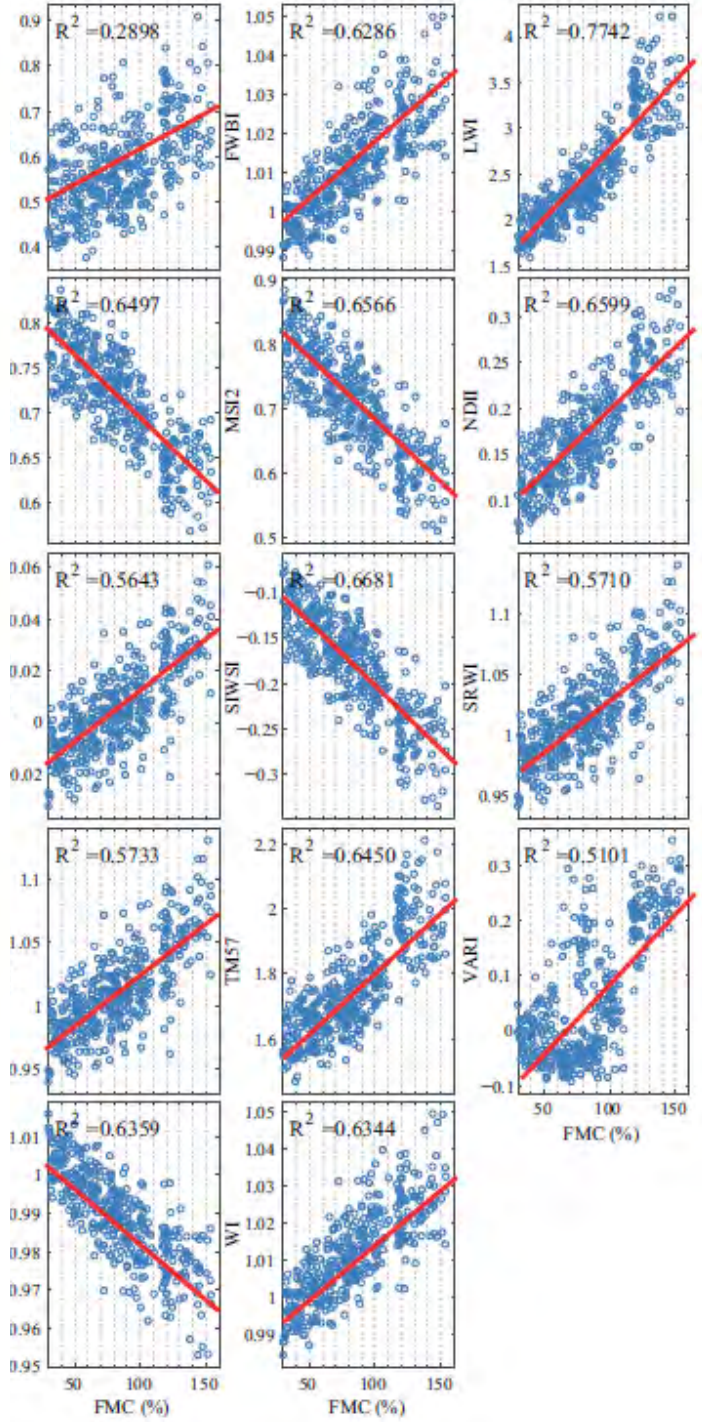


(b) *Eucalyptus globulus*



Acronym	Vegetation Index
DDI	Double Difference Index
EVI	Enhanced Vegetation Index
fWBI	Floating-position Water Band Index
LWI	Leaf Water Index
MSI	Moisture Stress Index
MSI1	Moisture Stress Index 1
MSI2	Moisture Stress Index 2
NDII	Normalized Difference Infrared Index
NDWI1	Normalized Difference Water Index 1
NDWI2	Normalized Difference Water Index 2
SIWSI	Shortwave Infrared Water Stress
SRWI	Simple Ratio Water Index
SRWI1	Simple Ratio Water Index 1
SRWI2	Simple Ratio Water Index 2
TM57	Ratio of Thematic Mapper Band 5 to Ban
VARI	Visible Atmospheric Resistant Index
WBI	Water Band Index
WI	Water Index

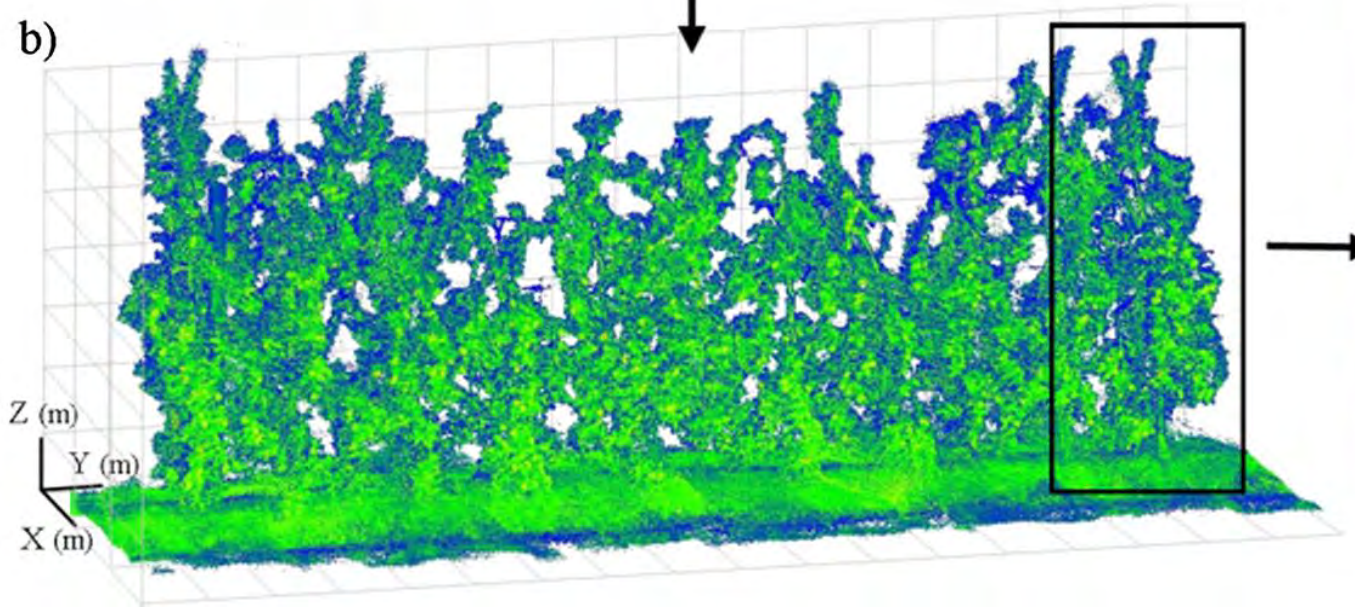


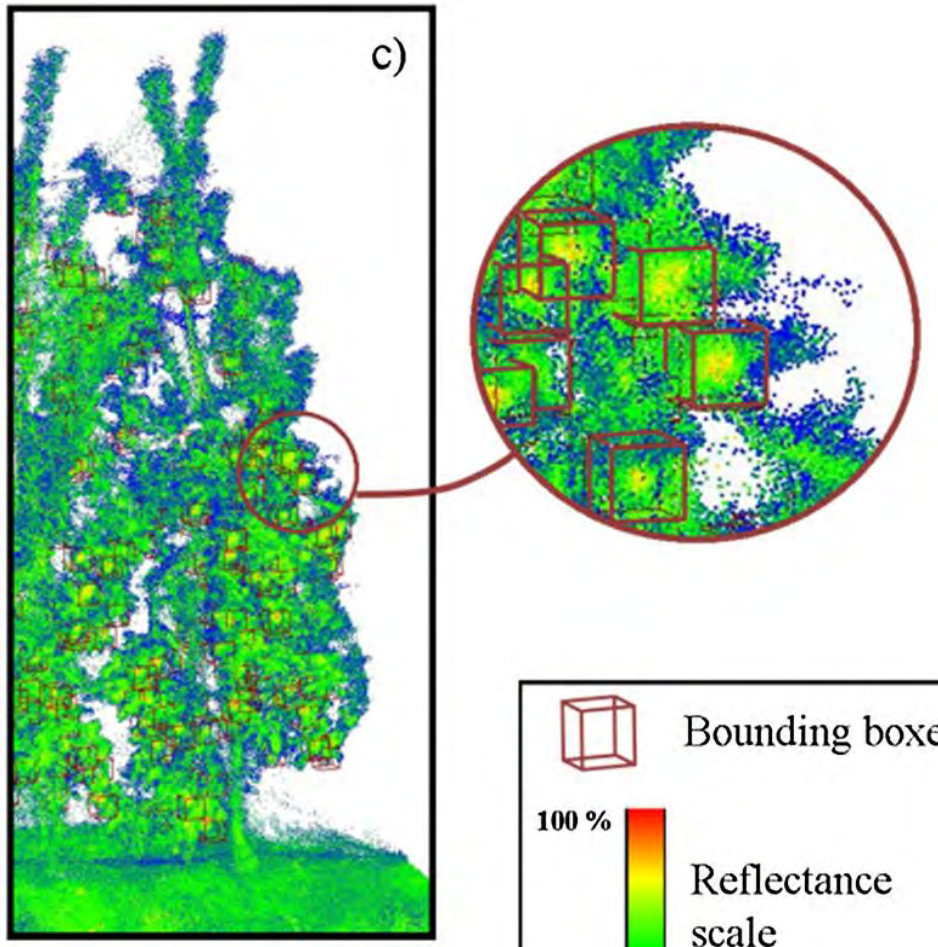


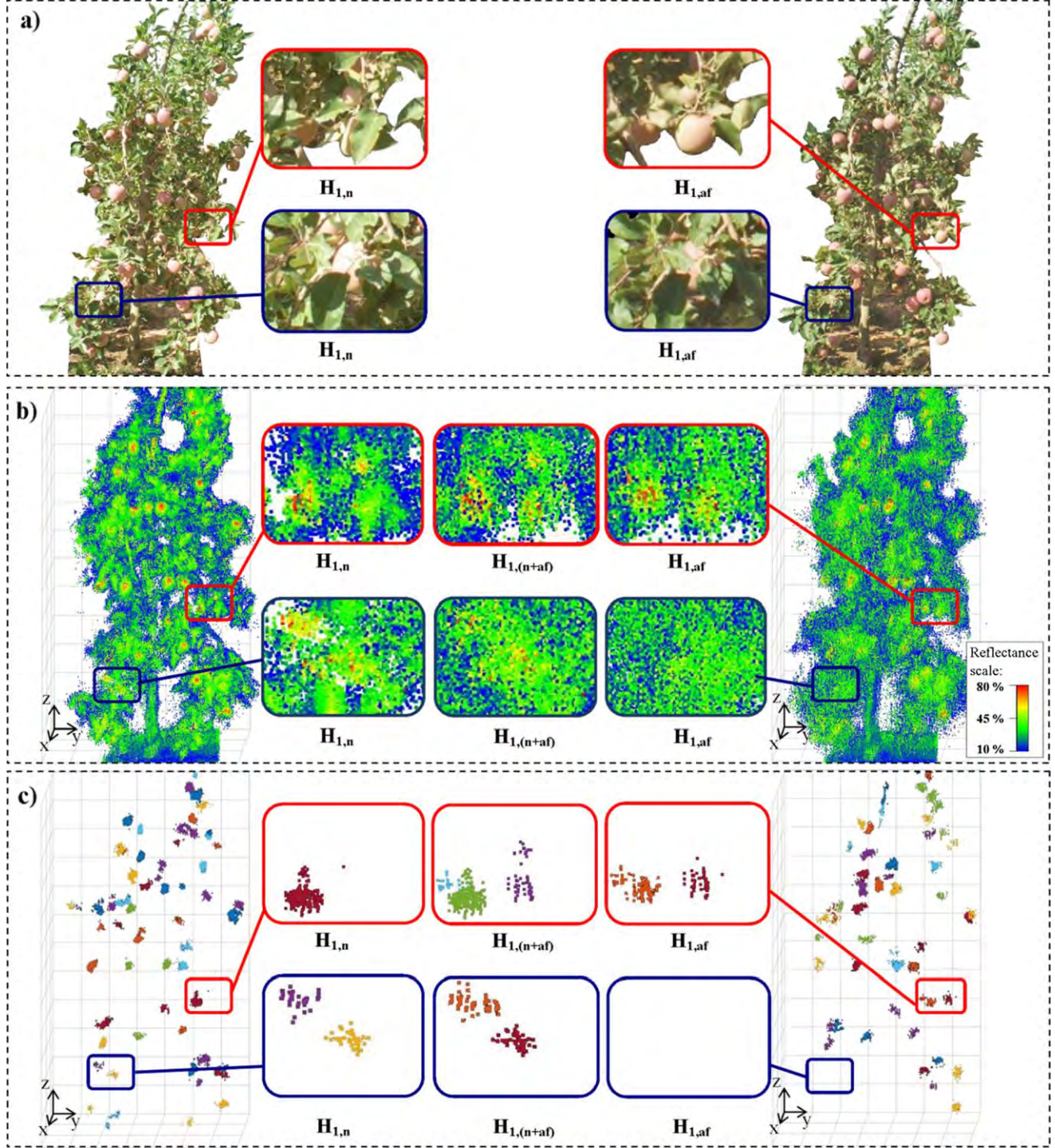

Characterization and phenotyping

Fruit detection, yield prediction and canopy geometric characterization using LiDAR with forced air flow

- Use of LiDAR in agriculture
- Point cloud processing
-
-

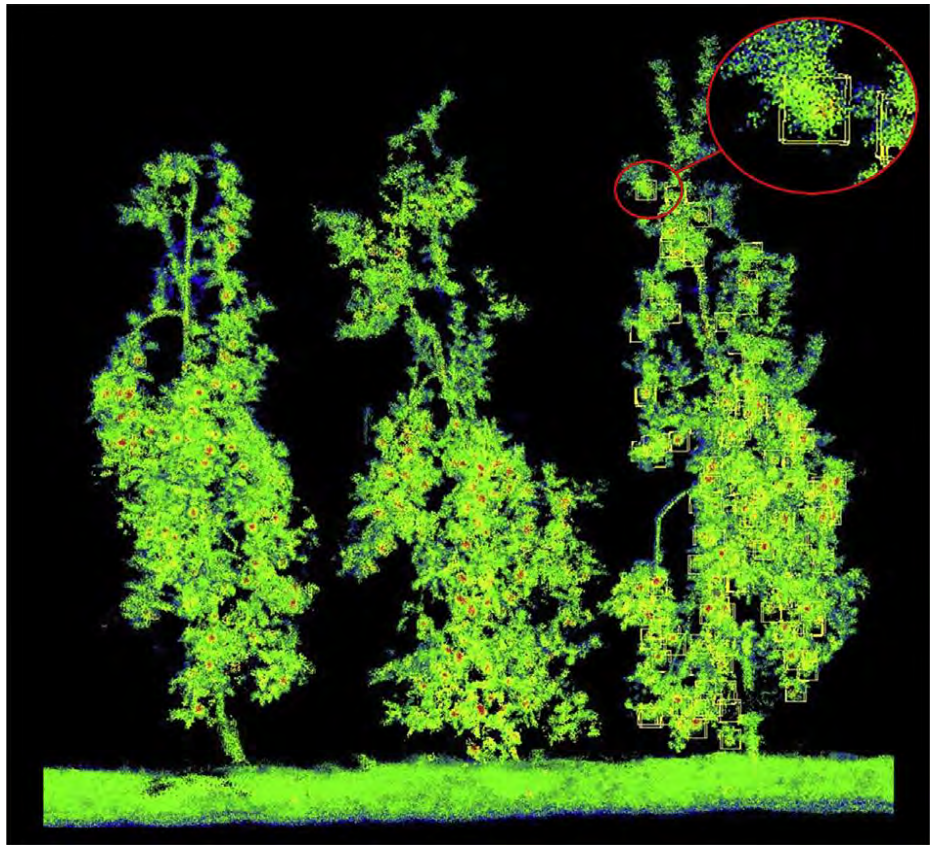


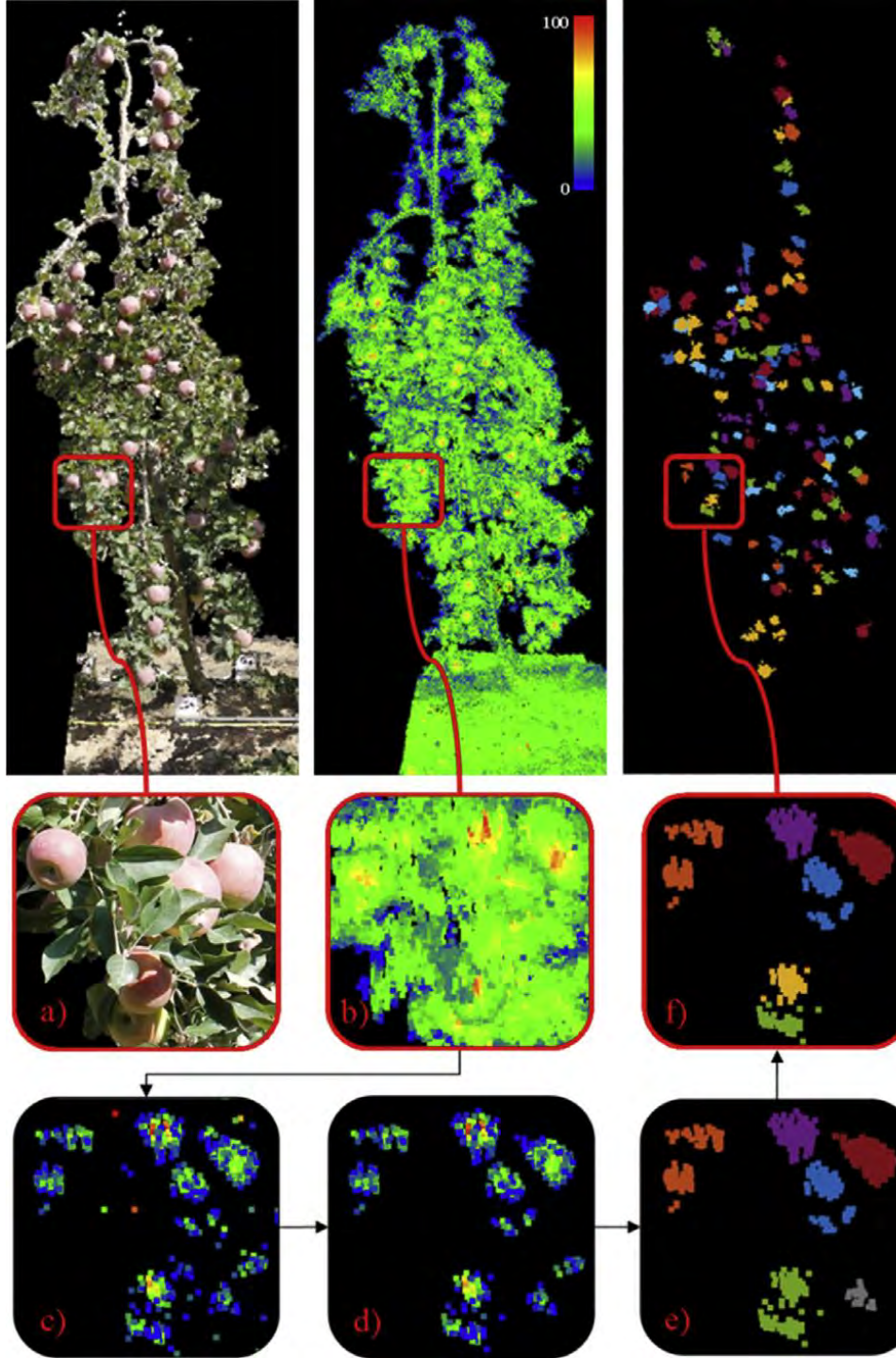



a)
$H_{1,n}$
$H_{1,af}$
$H_{1,n}$
$H_{1,af}$
b)
$H_{1,n}$
$H_{1,(n+af)}$
$H_{1,af}$
$H_{1,n}$
$H_{1,(n+af)}$
$H_{1,af}$
Reflectance scale:
80 %
45 %
10 %
c)
$H_{1,n}$
$H_{1,(n+af)}$
$H_{1,af}$
$H_{1,n}$
$H_{1,(n+af)}$
$H_{1,af}$

Fruit detection in an apple orchard using a mobile terrestrial laser scanner

- Ground LiDAR technology
- Point cloud processing / Machine Learning
- **TRL 3 (collaboration with Spain)**

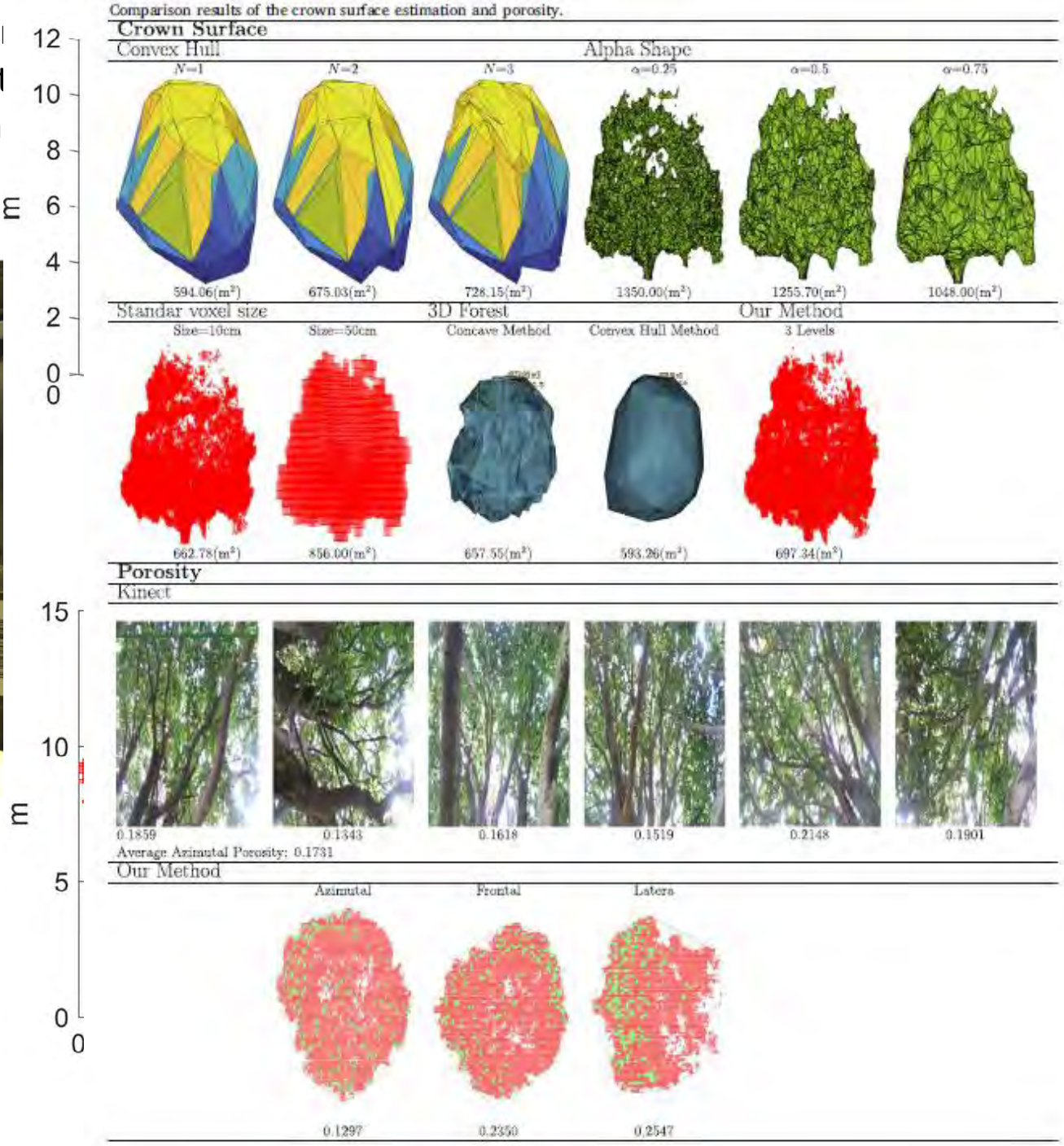


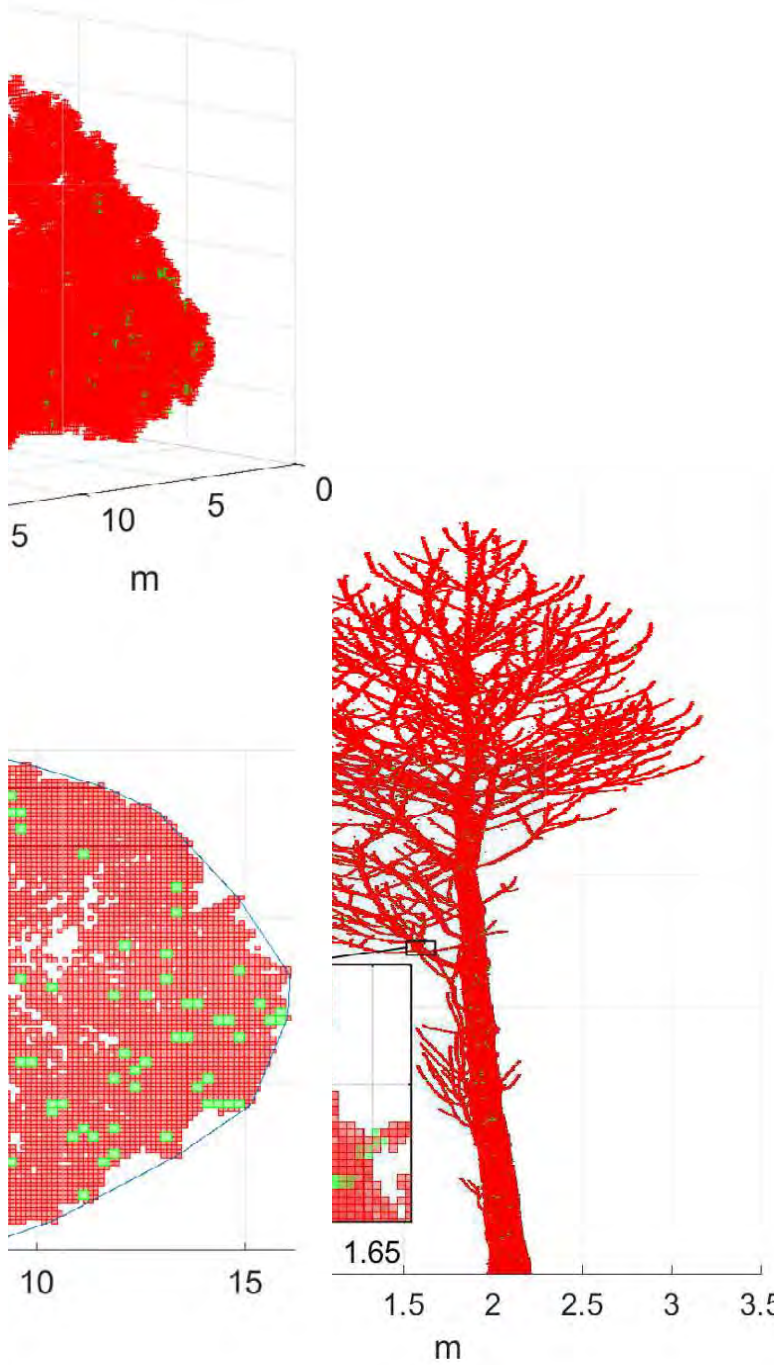


Mechatronic terrest

- Terrestrial LiDAR t
- Computational m
- Cloud processing
- **TRL 2**

(a)





(b)

Others:

Real-time approaches for characterization of fully and partially scanned canopies in groves

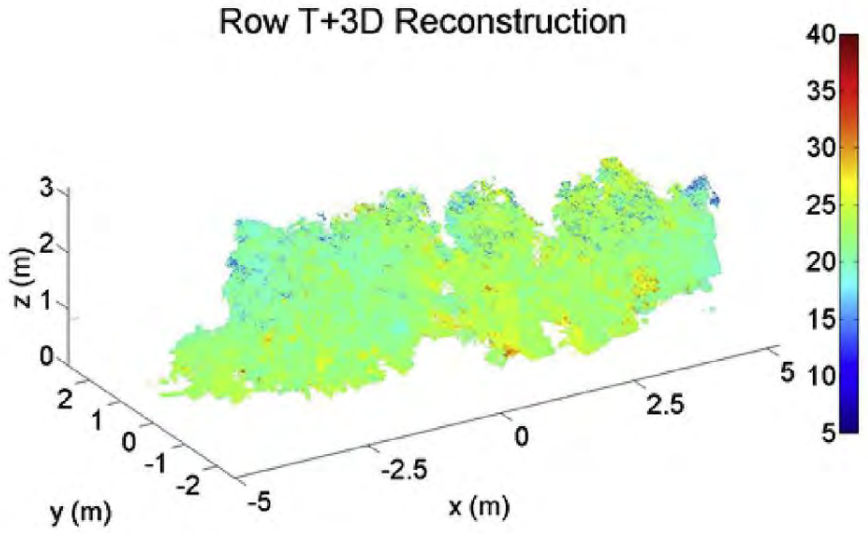
LiDAR and thermal images fusion for ground-based 3D characterisation of fruit trees

Advances in Structured Light Sensors Applications in Precision Agriculture and Livestock Farming

Capabilities:

- image processing
- deep learning/Artificial Intelligence/Machine Learning
- Data science/Data mining
- Features extraction

(a)

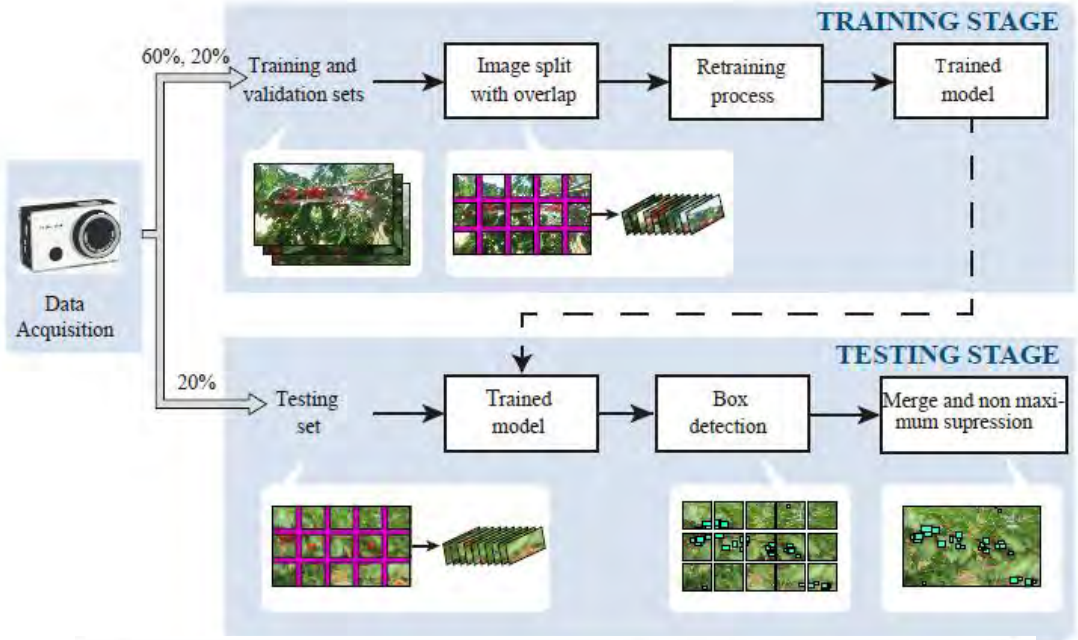


(b)

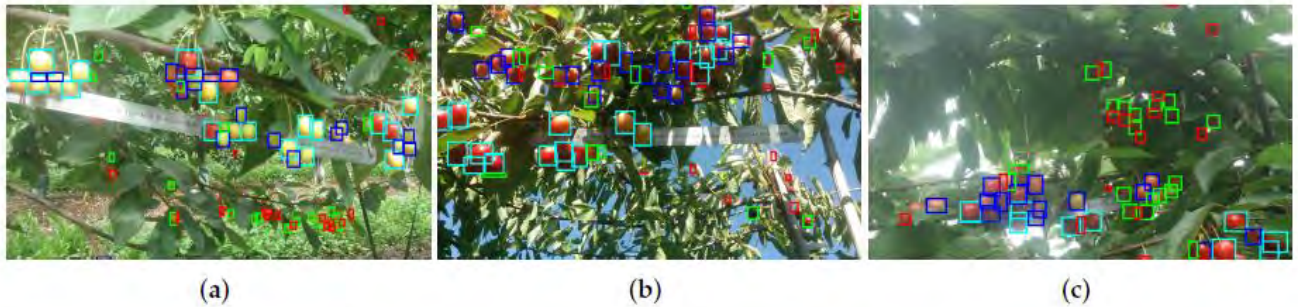
Fruit counting and harvest estimation

Detection and Characterization of Cherries: A Deep Learning Usability Case Study in Chile

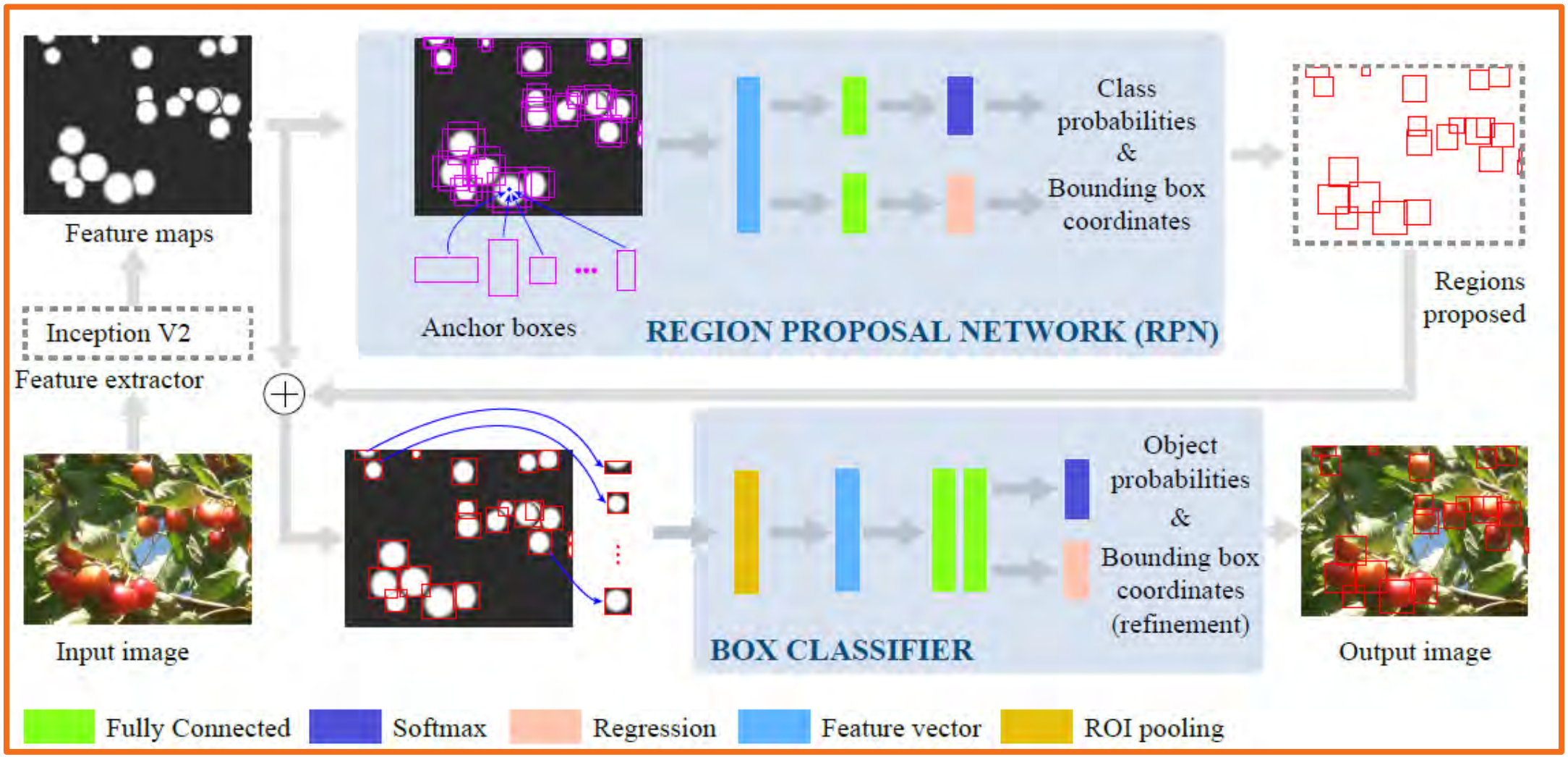
- Deep learning/machine learning
- Artificial vision system
- Fruit detection and counting
- Cloud processing
- Affordable technology
- **TRL 3 (industry partner)**

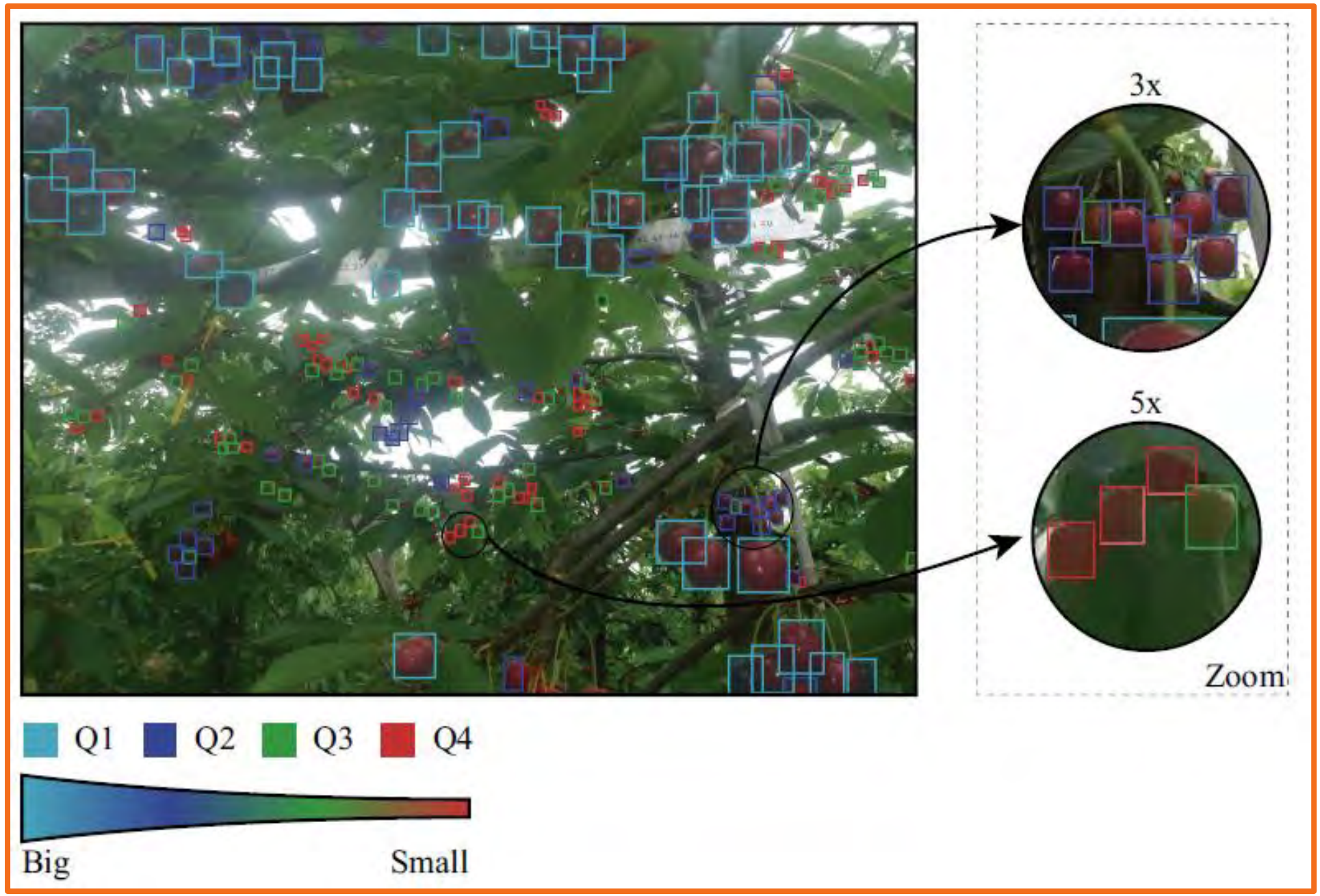


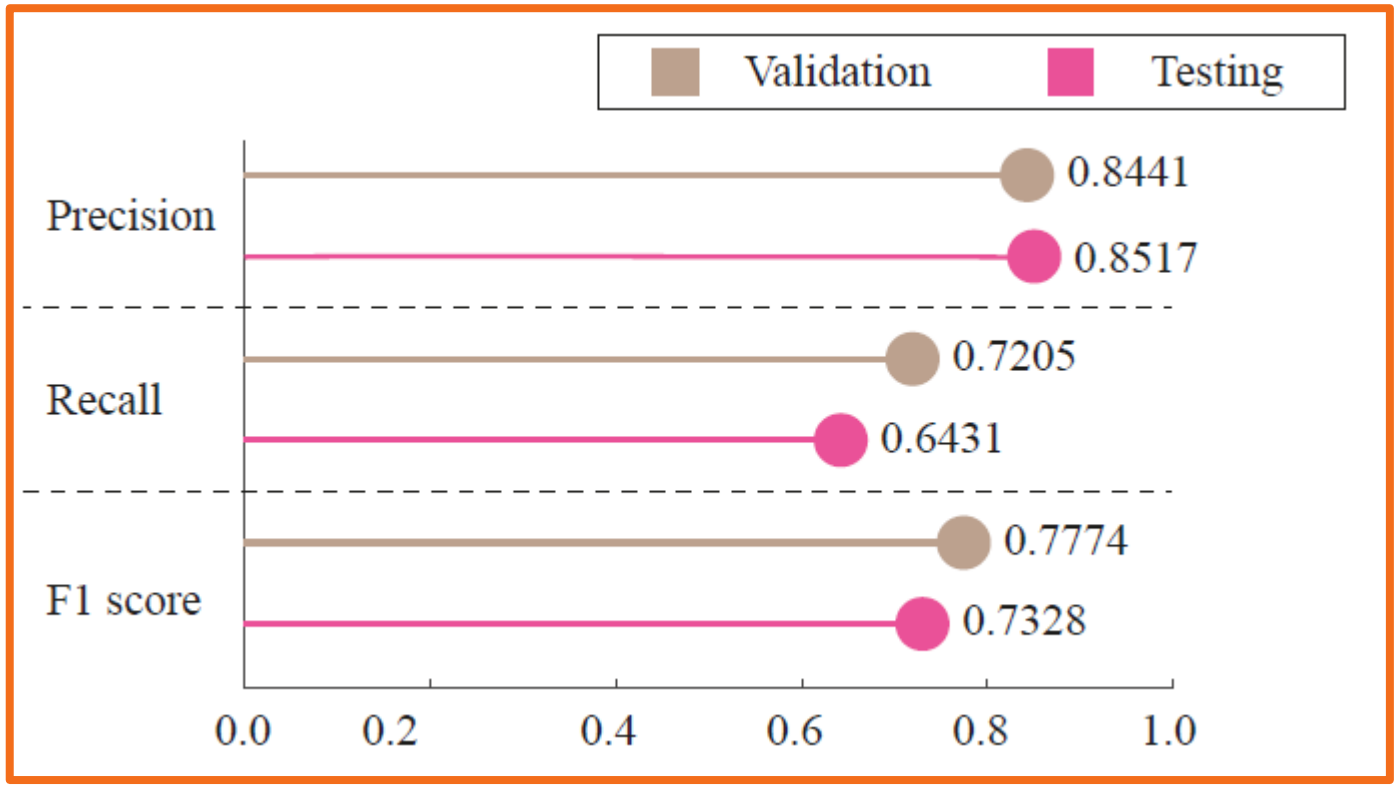
	Validation	Testing
Real number of berries	2698	2956
Number of berries detected	2303	2232



Faster RCNN


Feature maps
Inception V2
Feature extractor
Input image
Anchor boxes
Class probabilities & Bounding box coordinates
REGION PROPOSAL NETWORK (RPN)
Regions proposed
Object probabilities & Bounding box coordinates (refinement)
BOX CLASSIFIER
Output image
Fully Connected
Softmax
Regression
Feature vector
ROI pooling


3x
5x
Zoom
Q1
Q2
Q3
Q4
Big
Small



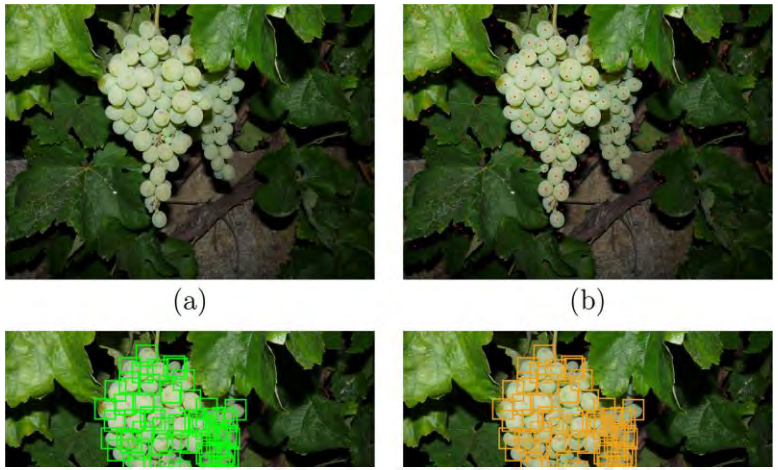
$$R = \frac{TP}{TP + FN}$$

$$R = \frac{TP}{TP + FN}$$

$$F1 = 2\frac{TP.FP}{TP + FP}$$

	Validation	Testing
Real number of berries	2698	2956
Number of berries detected	2303	2232

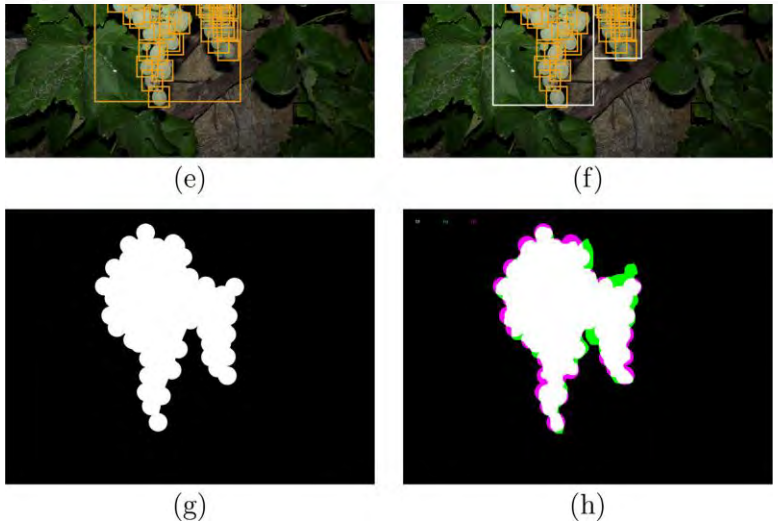
A pattern recognition strategy for visual grape bunch detection in vineyards



(a) (b)

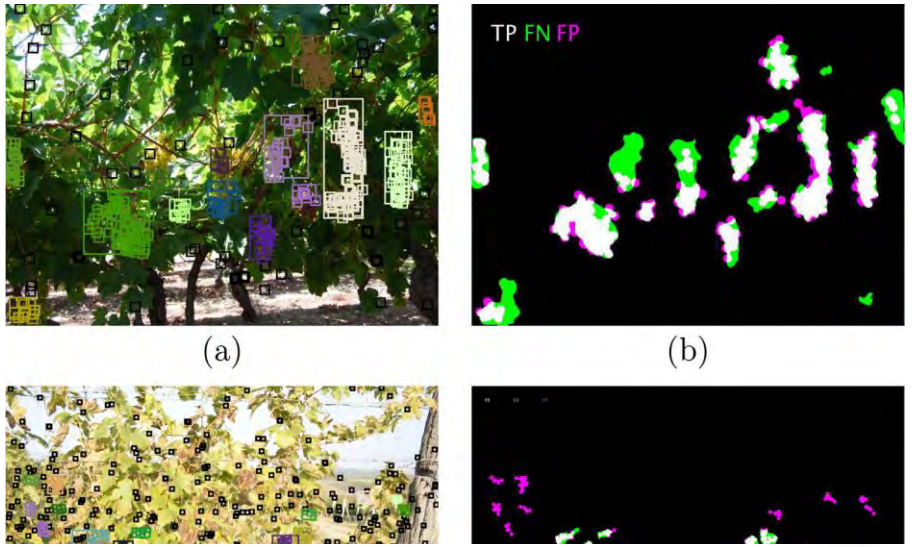
Grape bunch detection results for each dataset.

Dataset	Israel	Iceland	Portugal	Chile	
Images	129	3	15	16	
Resolution	800 × 600	3888 × 2592	3648 × 2736	5472 × 3648	Average
Avg. prc. %	88.46 ± 4.34	83.02 ± 8.80	96.67 ± 7.04	86.28 ± 3.95	88.61
Avg. recall %	82.43 ± 5.03	81.63 ± 8.94	76.22 ± 14.52	81.06 ± 4.42	80.34

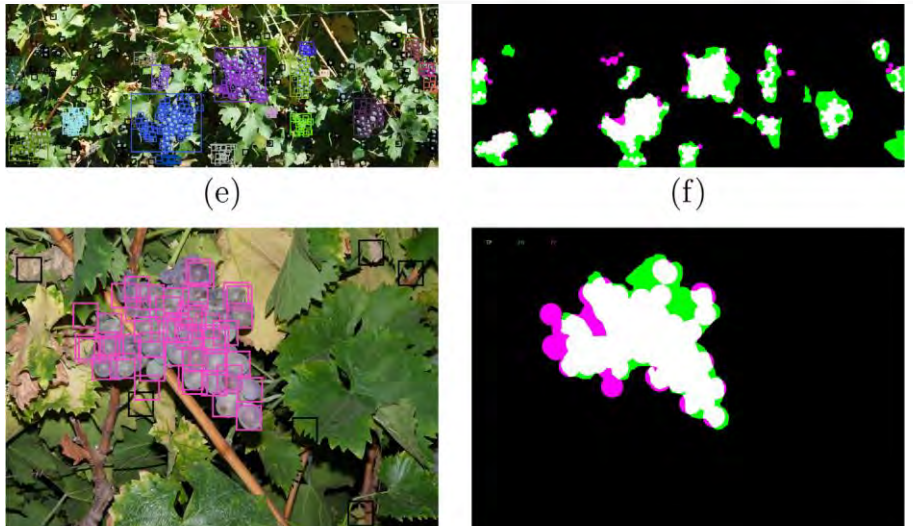


(e) (f)

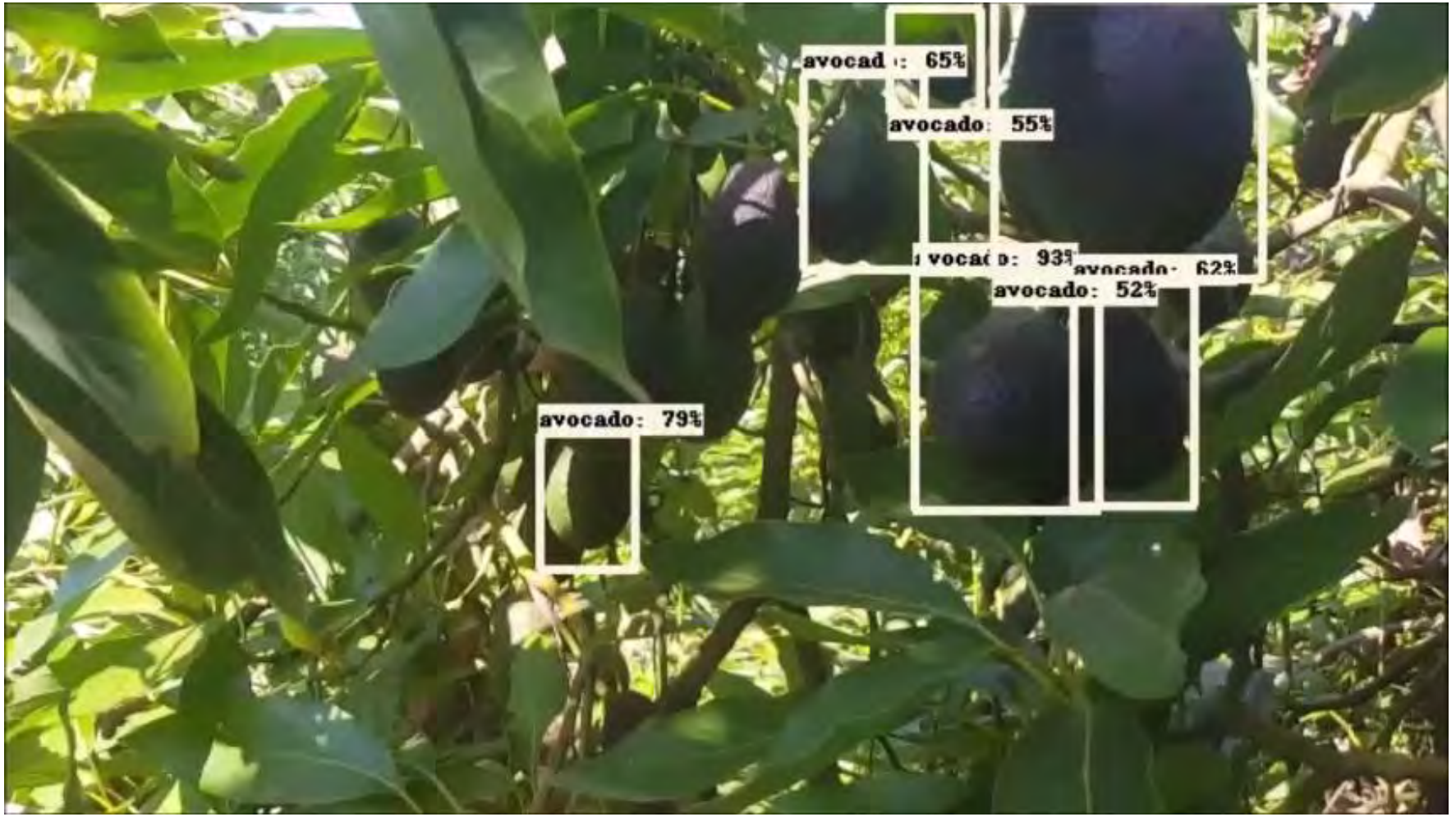
(g) (h)



(a) (b)



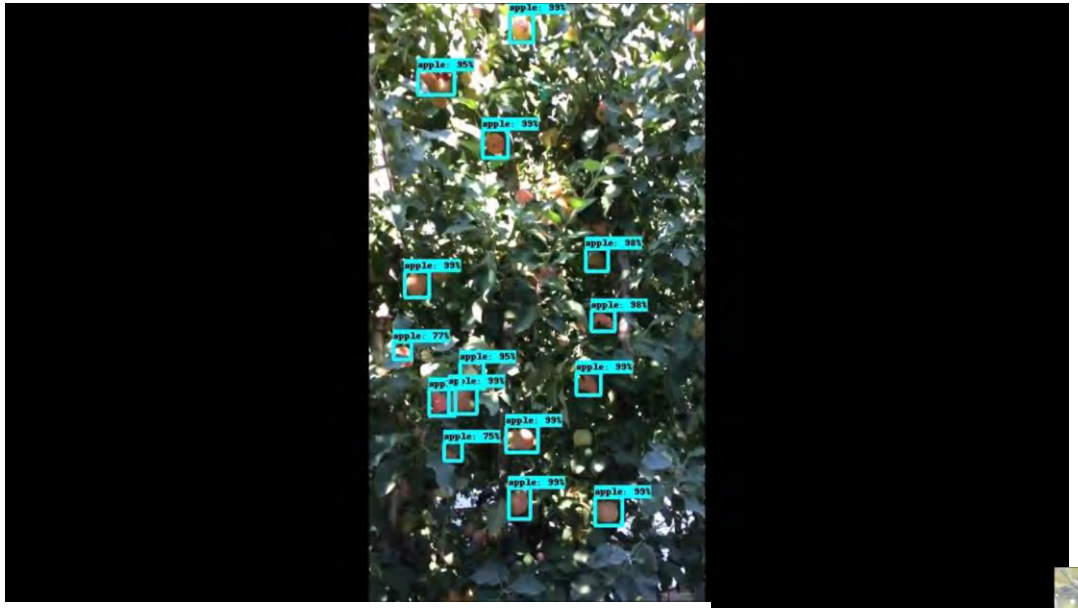
(e) (f)

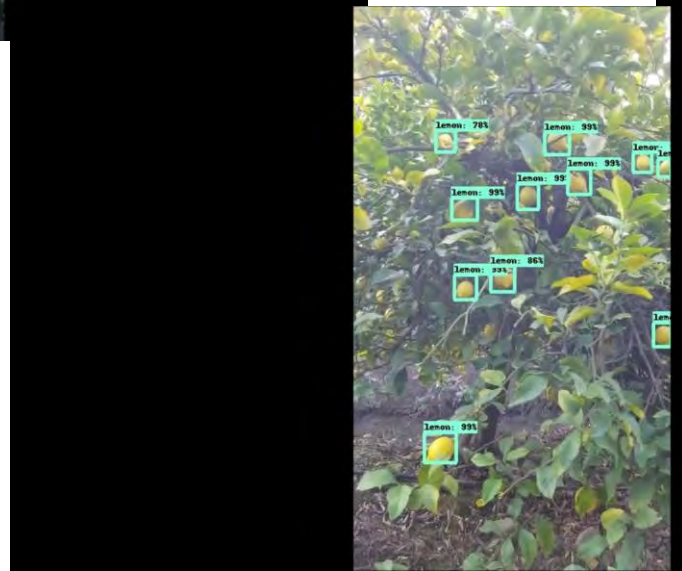


Error less than 10% in fruit counting

Comparison of convolutional neural networks in fruit detection and counting: A comprehensive evaluation

- Advocados, lemons and apples
- Work done with UC Davis, USA
- TRL 4 -> 5





Error less than 10% in fruit counting

Toward Semantic Action Recognition for Avocado Harvesting Process based on Single Shot MultiBox Detector

UNIVERSIDAD TECNICA
FEDERICO SANTA MARIA

IEEE ICA-ACCA 2018

DEPARTAMENTO DE
ELECTRONICA

Authors: Juan Pablo Vásconez Hurtado, Jaime Salvo, Fernando Auat Cheein

Bio Bio - Chile, Oct 2018


Questions


Robotics / Mechatronics

Energy assessment: making vehicles more efficient

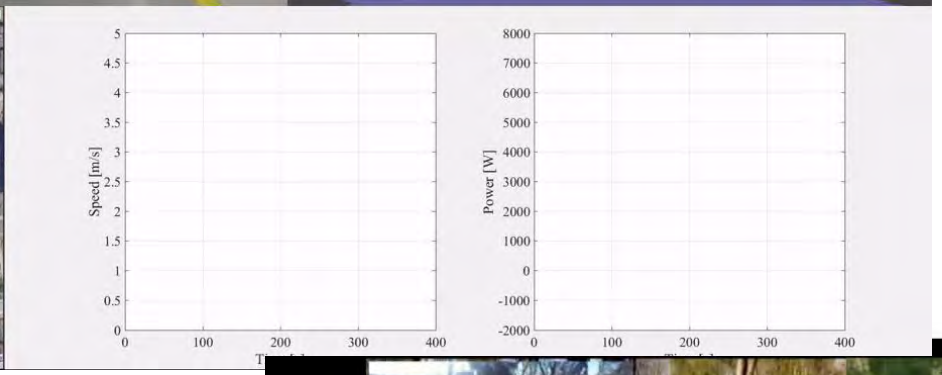
- Distributed tube-based nonlinear MPC for motion control of skid-steer robots with terra-mechanical constraints
  - **TRL 3, combustion engine**
- H∞-Based Terrain Disturbance Rejection for Hydraulically Actuated Mobile Manipulators with a Nonrigid Link
  - **TRL 2, hydraulic + combustion**
- Headland turning algorithmization for autonomous N-trailer vehicles in agricultural scenarios
  - **TRL 3, electric vehicle**
- Tube-based nonlinear model predictive control for autonomous skid-steer mobile robots with tire–terrain interactions
  - **TRL 3, combustion engine**
- Prognosis of the energy and instantaneous power consumption in electric vehicles enhanced by visual terrain classification
  - **TRL 3, electric**
- Assessment of power consumption of electric machinery in agricultural tasks for enhancing the route planning problem
  - **TRL 3, electric**

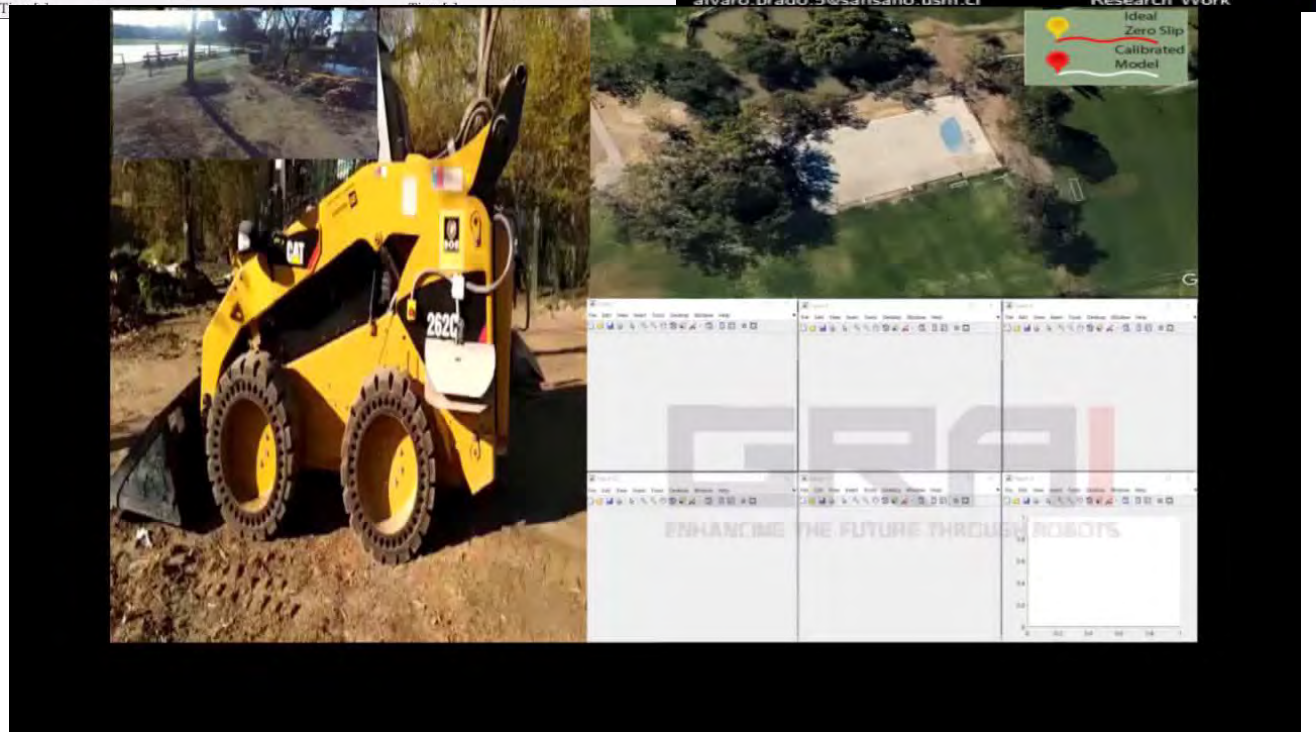
Tuning of Trajectory Tracking Controllers Based on Navigation Surface Information for Autonomous Ground Vehicles

Alvaro Javier Prado, Francisco Javier Yandún, Fernando Auat Cheein

Department of Electronic Engineering, Universidad Tecnica Federico Santa María, Valparaiso, Chile

Field tests in the terrains of the Vineyard Casa Blanca & other navigation surface conditions, Chile

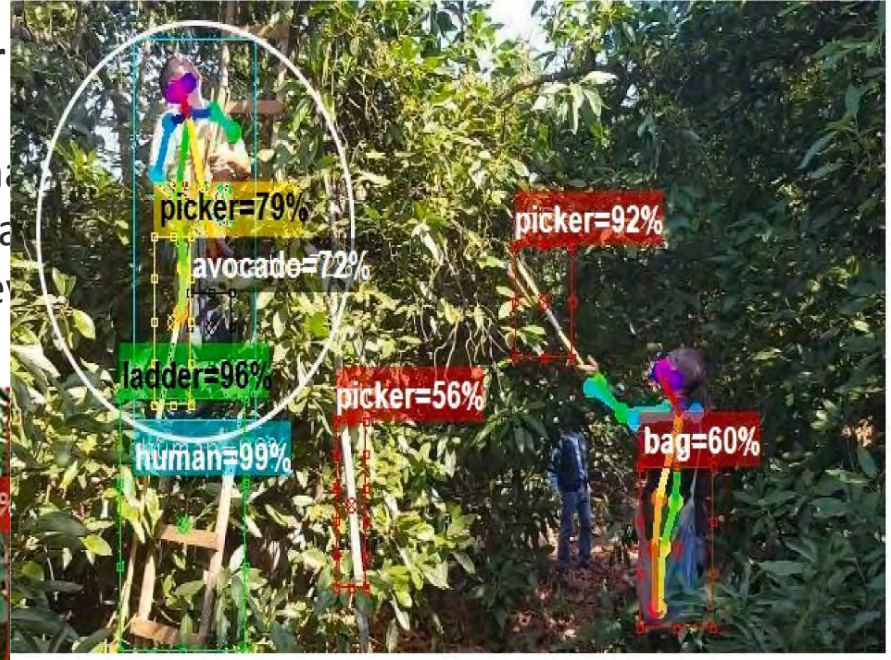


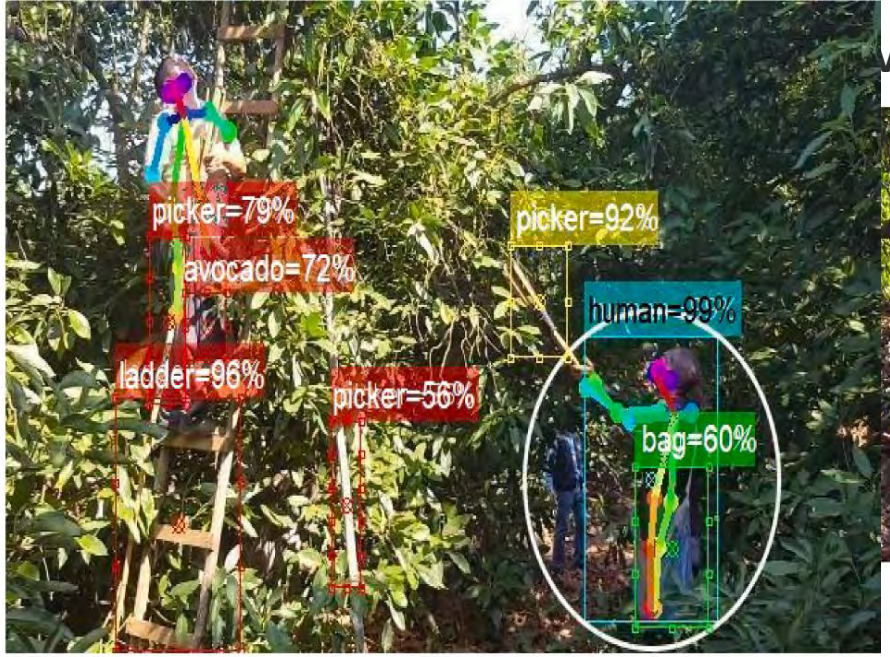



Human-Robot Interaction

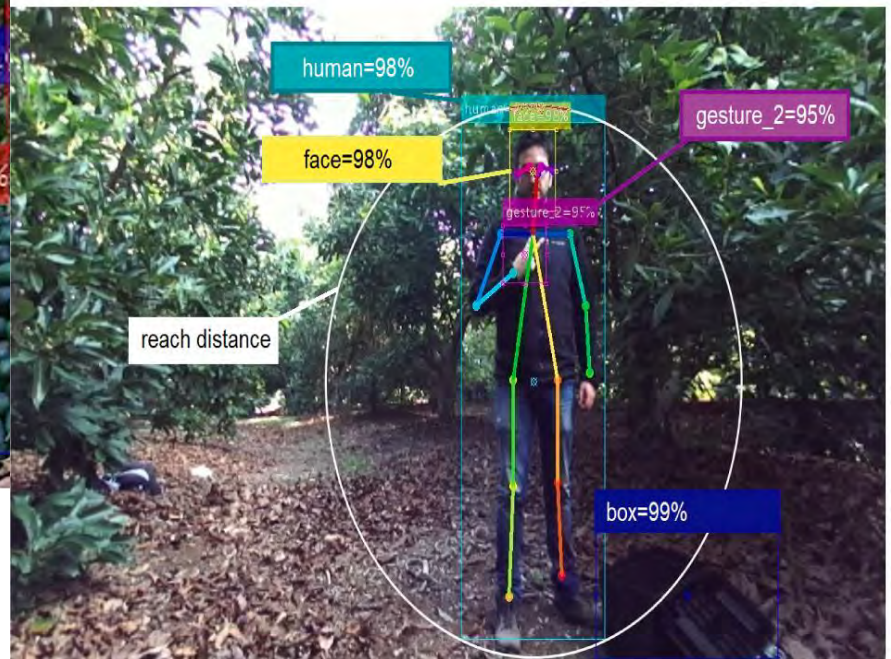
A methodology for **vesting processes**

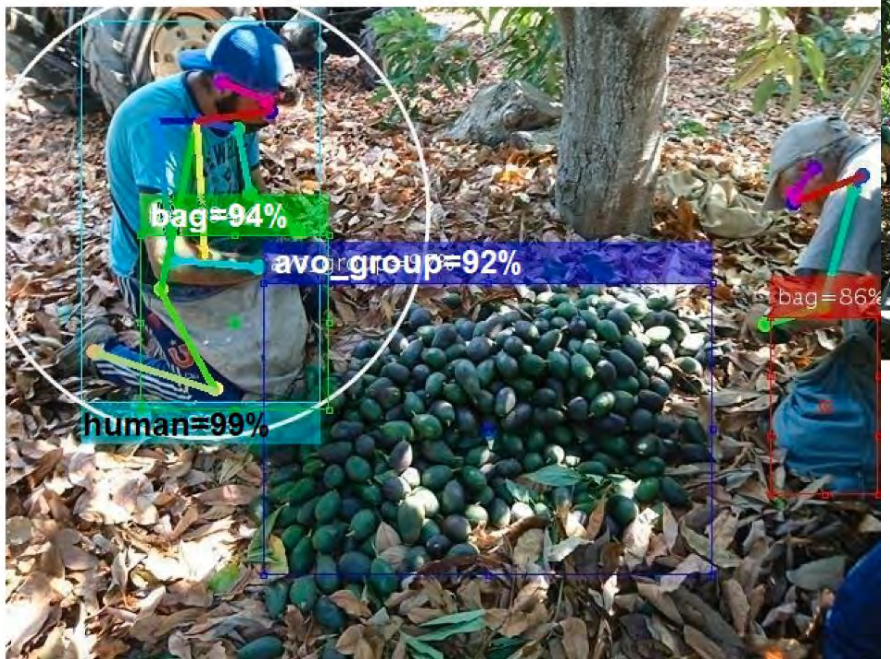
- Tracking of huma
- Workload evalua
- Human health e
- **TRL 3**





(d)

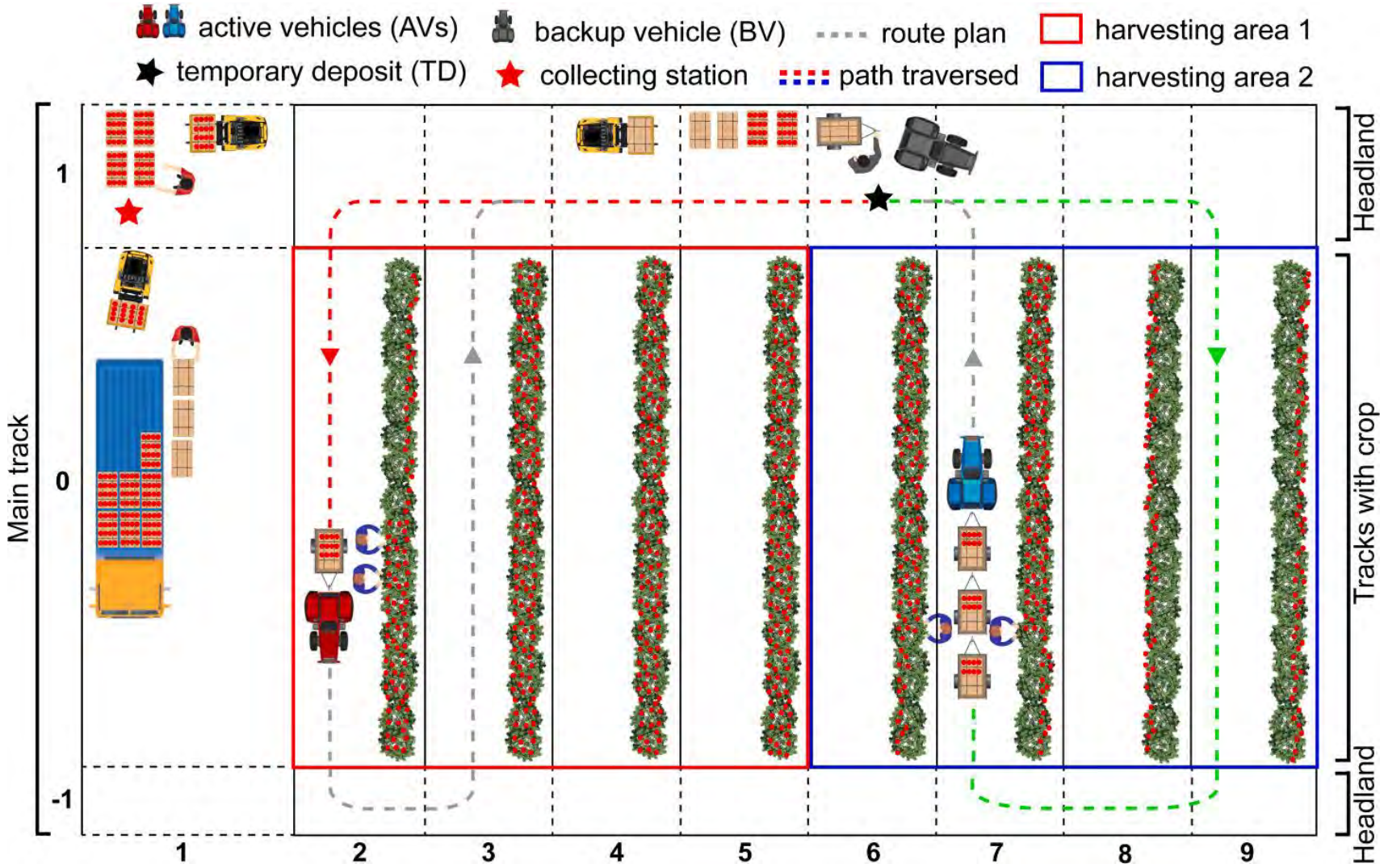




(c)

Improving the manual harvesting operation efficiency by coordinating a fleet of N-trailer vehicles

- Multi-vehicle logistics
- Interaction with field workers
- latency minimization during harvesting
- **TRL 2** (work with Portugal)



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