



# 4th EU-Japan Satellite Positioning Roundtable

**María Campo-Cossío**

**Head of Navigation and Robotics**

[mcampo@centrotecnologicoCTC.com](mailto:mcampo@centrotecnologicoCTC.com)



## CTC is a Technology Centre.

Its main objective is to contribute toward economic and social development by supporting the companies to assess the technological feasibility of their ideas, as well as technically run their projects in research, development and innovation.



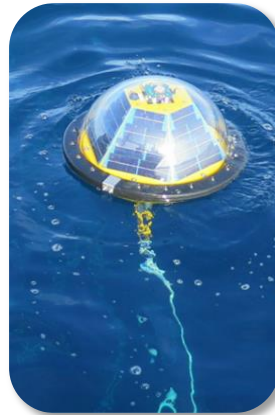
# Navigation systems and Autonomous Vehicles

## Precise Positioning and Attitude

- GNSS Precise Positioning Techniques (eg. PPP, RTK)
- GNSS Attitude estimation (Roll, Pitch, Yaw)
- GNSS and INS Integrated Navigation
- Sensor fusion
- Indoor/Outdoor Navigation Solutions



People surveillance and Localisation



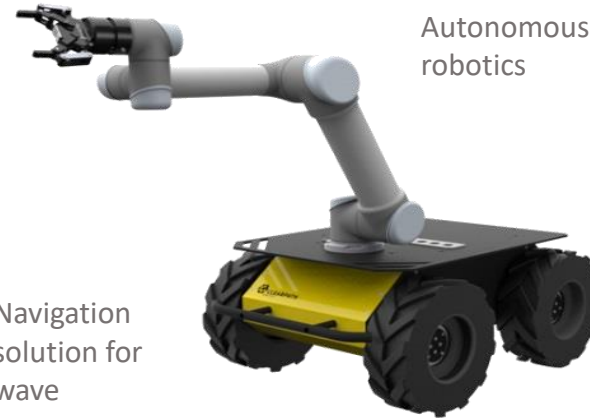
Navigation solution for wave measurement



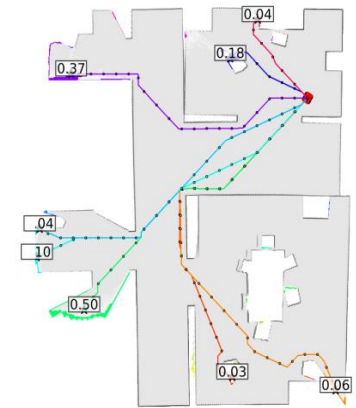
Navigation systems for UAV

## Navigation and Guidance

- SLAM algorithms for autonomous vehicle navigation
- Frontier-based exploration
- Path planning and obstacle avoidance
- Real time solutions
- Development of HW/SW solutions for specific applications.



Autonomous robotics



Exploration and mapping

## Sensors Integration and Modelling

- Sensor characterization:
  - ✓ Motion simulator
  - ✓ GNSS sensor characterization facilities
- Sensor modeling
- Data fusion and processing



Motion simulator



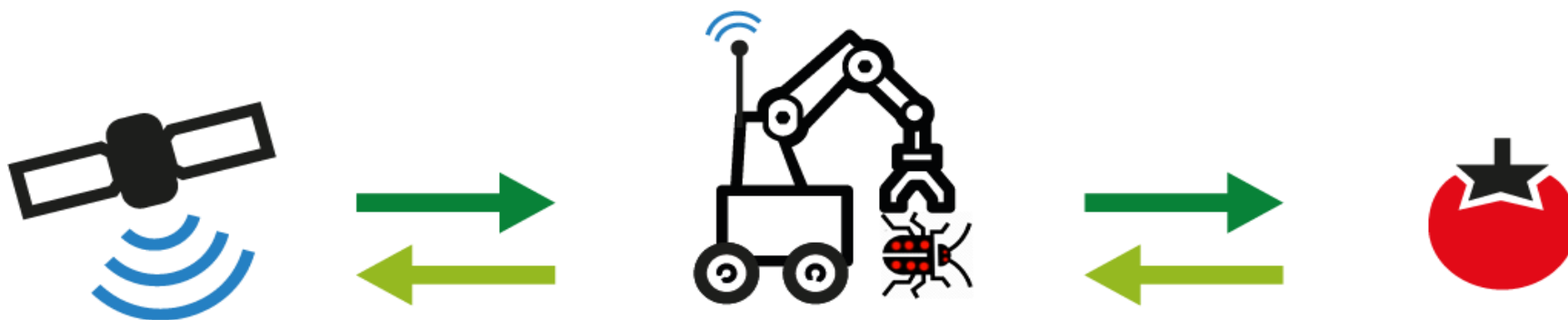
# GREENPATROL PROJECT



European  
Global Navigation  
Satellite Systems  
Agency

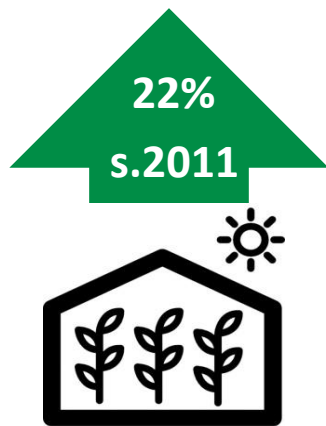


## Galileo Enhanced Solution for Pest Detection and Control in Greenhouse Fields with Autonomous Service Robots



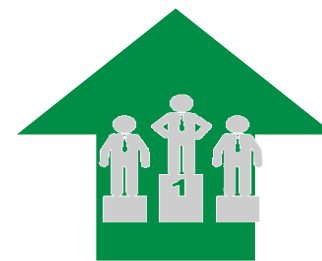


# Produce more with less





- Autonomous Navigation
- GNSS precise positioning
- Light indoor environment
- Early detection and Treatment



# Greenhouse challenges



- Multipath and occlusion
- Changing environment
- Need of precise positioning and online map generation





# How?



## Robot precise positioning solution

- GNSS + INS + Odometry (Absolute)
- Range based systems (Relative)

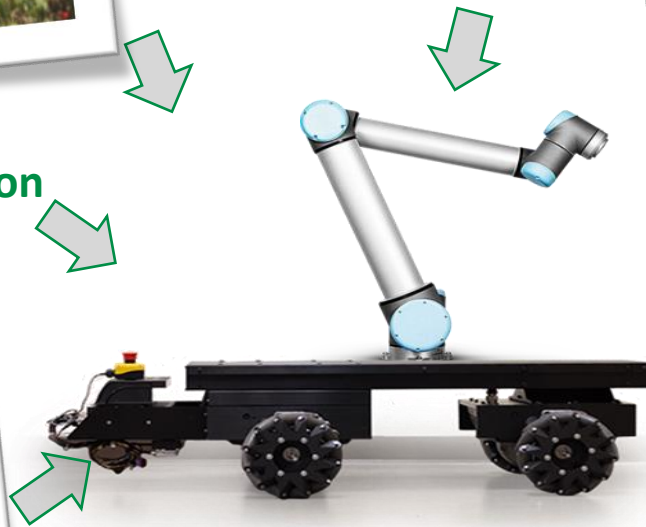
## Cognitive vision system

- Image processing
- Machine learning classification

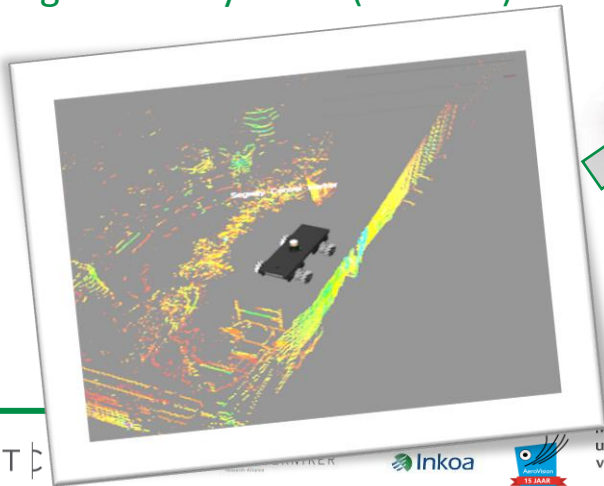


## Robot Navigation

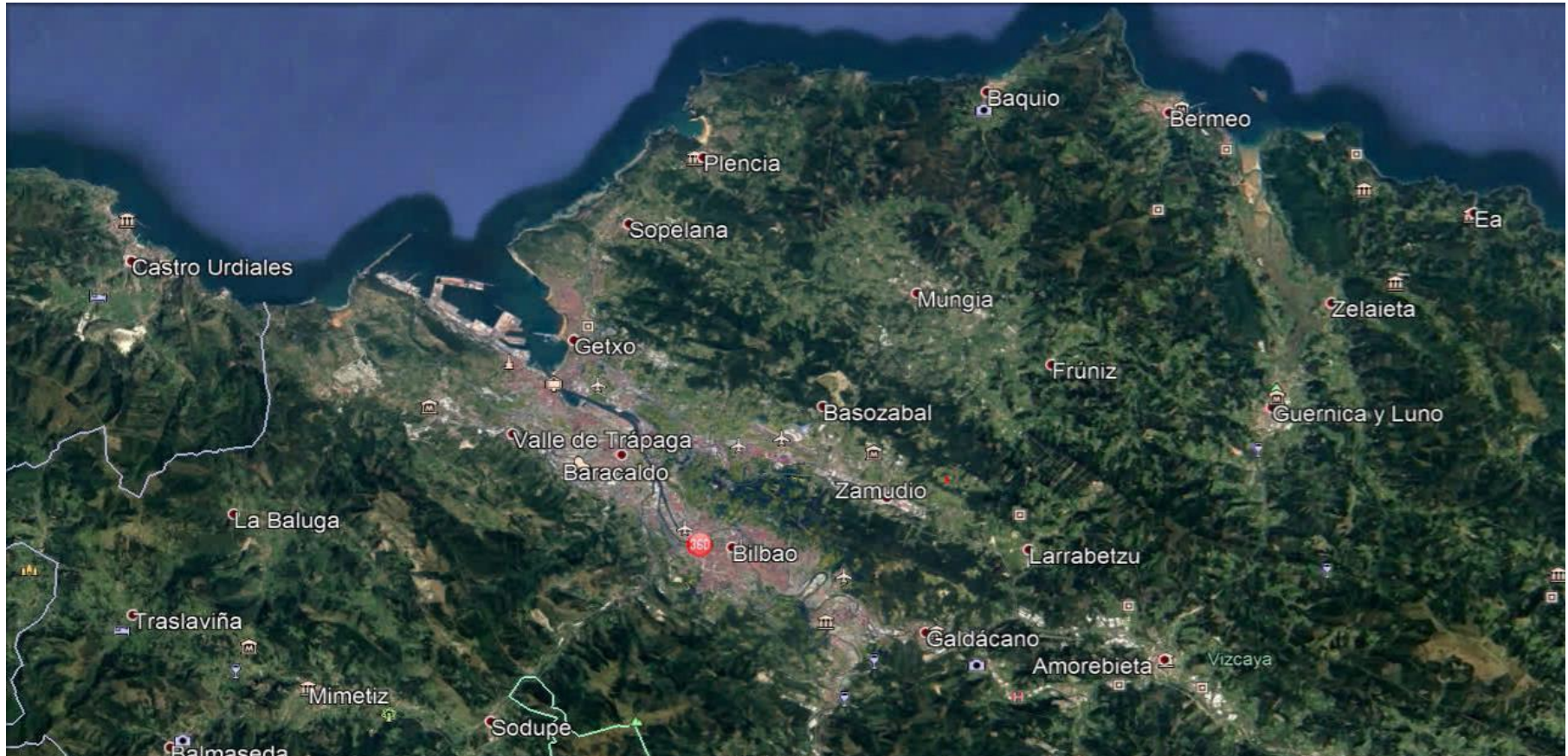
- Localization
- Adaptive navigation
- Path planning



COTS sensors, platform and manipulator



# GNSS in light Indoor scenario

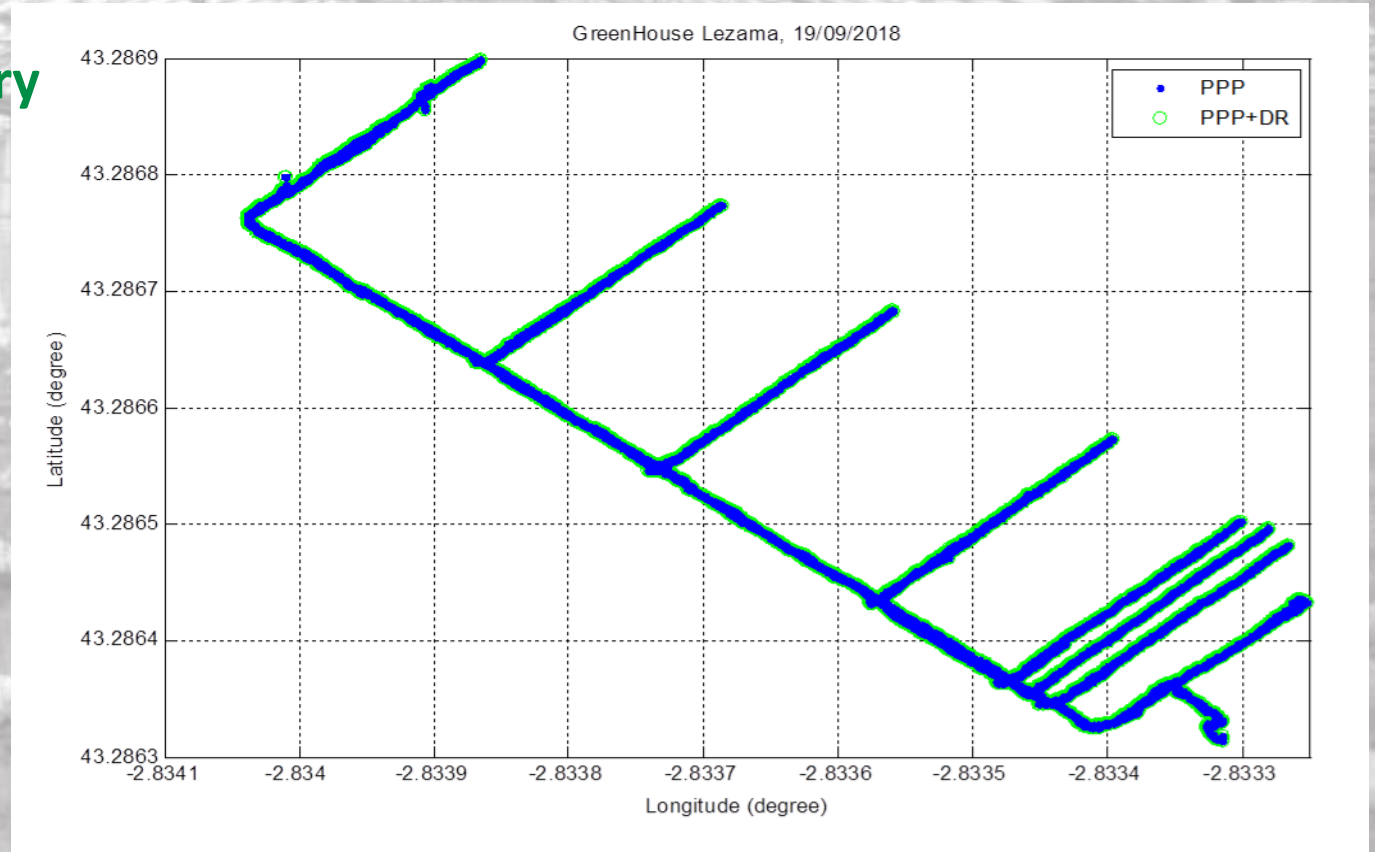


# GNSS in light Indoor scenario

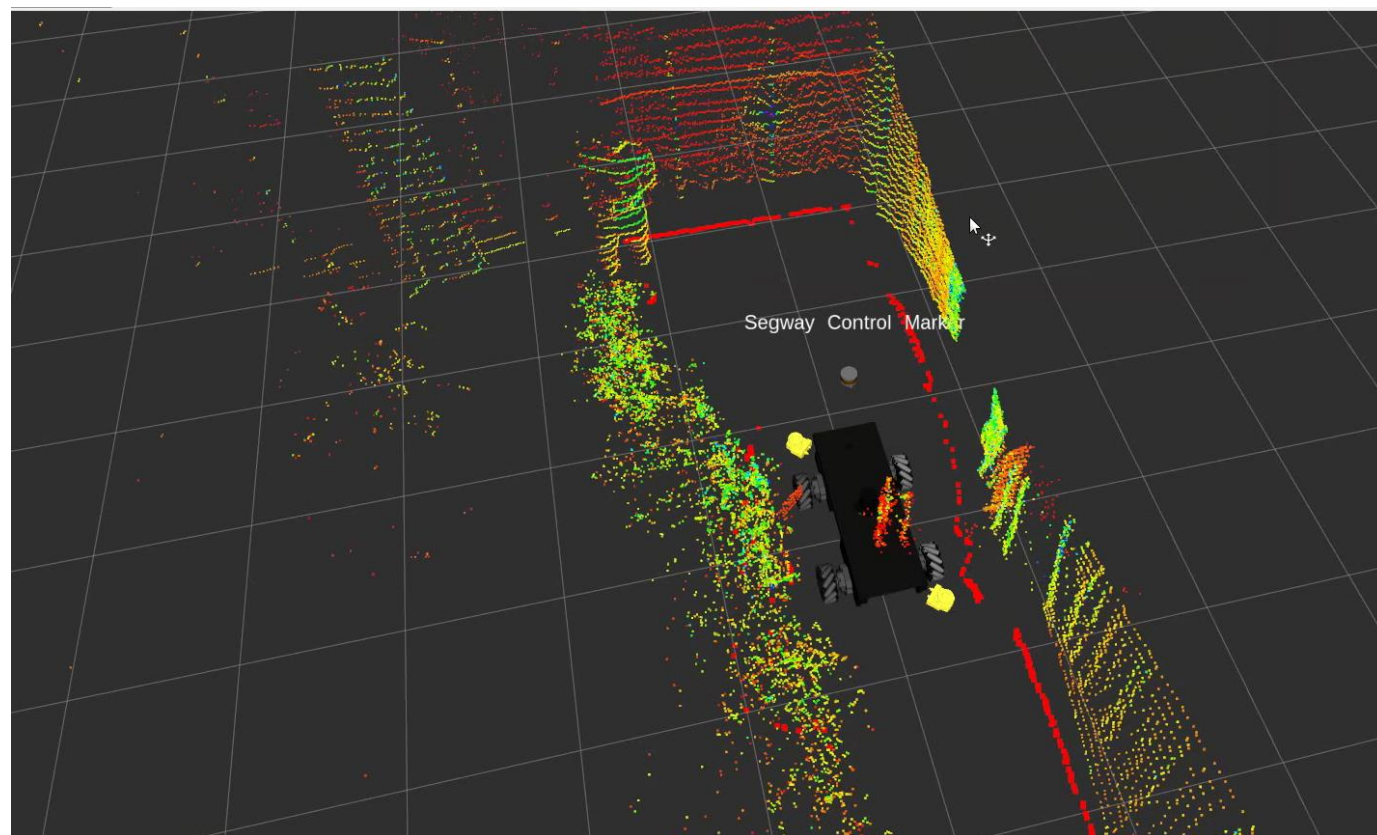
GNSS + INS + Odometry  
PPP + DR



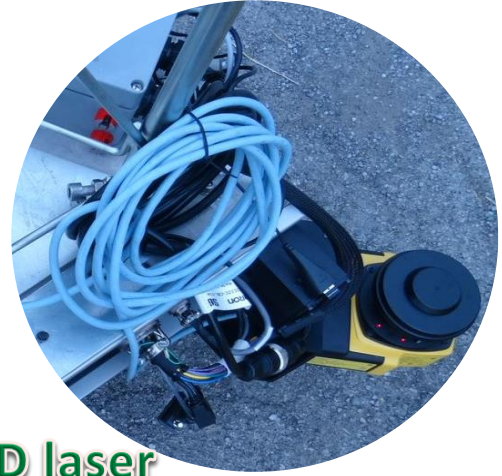
< 20 cm accuracy



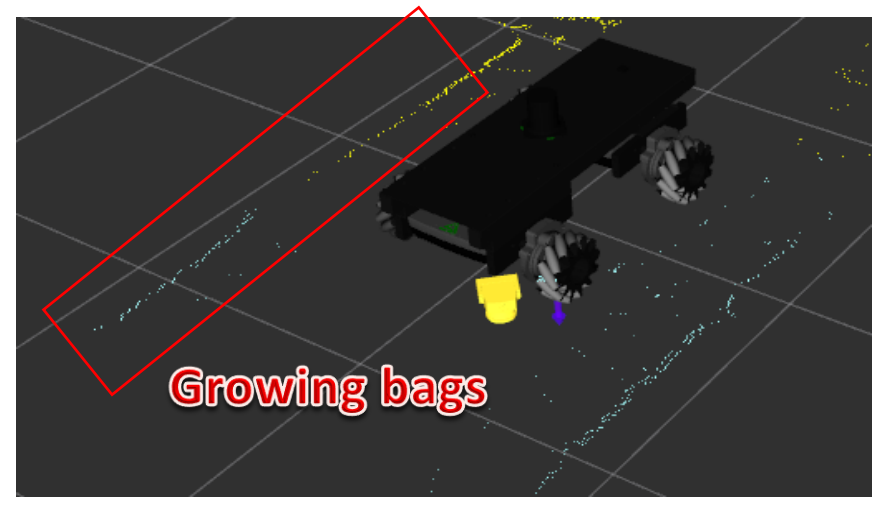
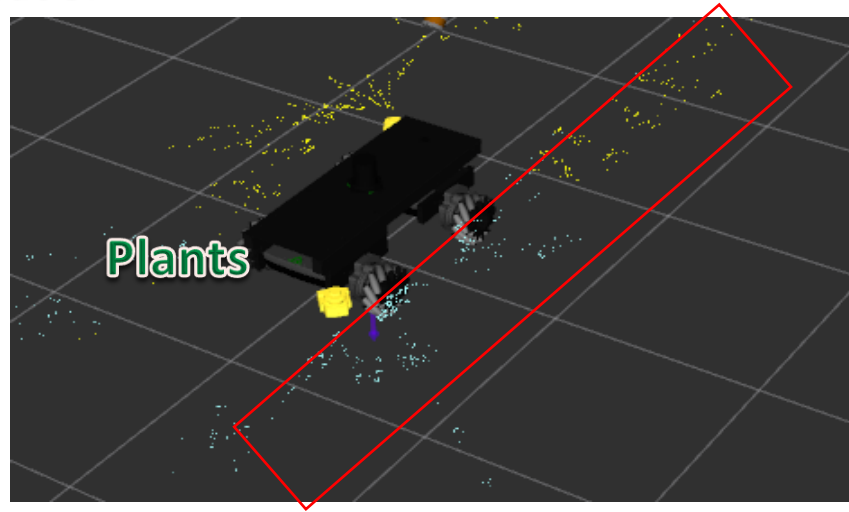
## 3D Laser for safety and mapping



# Robot Navigation



2D laser

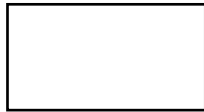




# Map Generation (SLAM)



Unknown Area



Empty Area



Obstacles

Using Odometry + Ins

## Odometry + INS + Range sensors



# Map Generation (SLAM)



Unknown Area



Empty Area



Obstacles

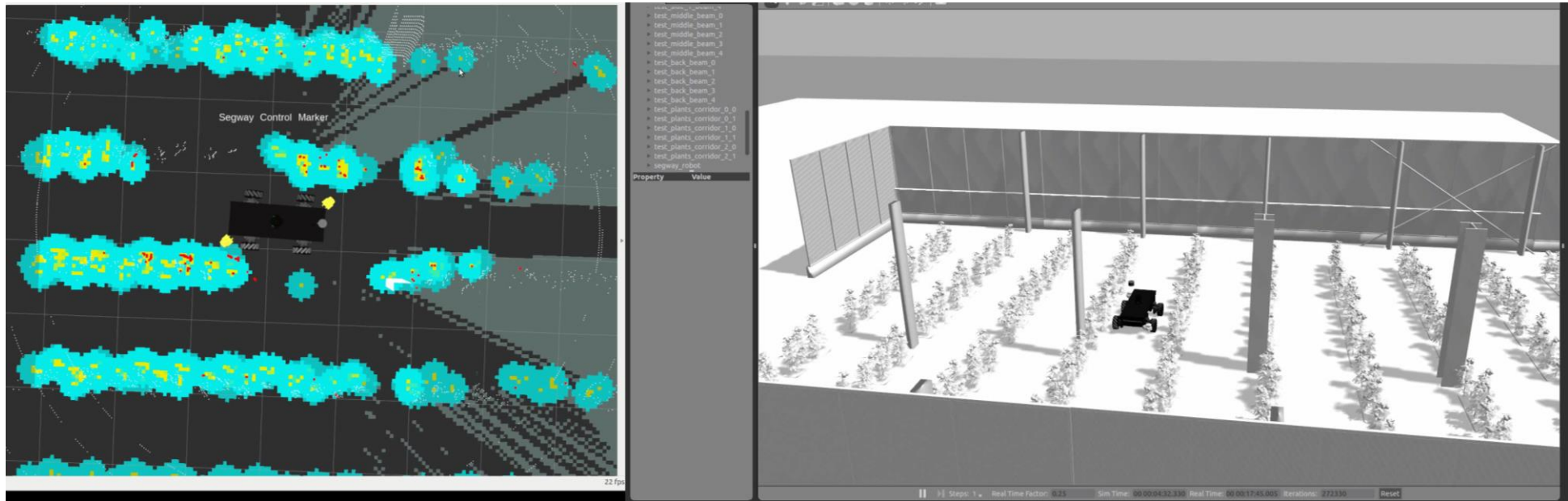
Using GNSS + Odometry + Ins

## GNSS+ Odometry + INS + Range Sensors



# Robot Navigation

## Training in simulated environment







[www.greenpatrol-robot.eu](http://www.greenpatrol-robot.eu)

