ROS for Education and Applied Research: Practical Experiences

Ralph SEULIN*, Raphael DUVERNE*, Olivier MOREL*, Cansen JIANG*, Jeremie DERAY**, Jordi PAGES**,
Lee KIAN SENG***, Remi GROSLEVIN*, Cedric DEMONCEAUX*, David FOFI*, Yohan FOUGEROLLE*

*CNRS UMR 6306 / University of Bourgogne Franche-Comté - FRANCE
** PAL Robotics - Barcelona - SPAIN
*** Universiti Teknologi PETRONAS - MALAYSIA

ROSCon 2015 - Hamburg - October 3-4, 2015

Context of Work

University of Burgundy - FRANCE

- ✓ **European Master in VIsion & roBOTics (ViBot)**
  - > Erasmus Mundus Programme
  - > Girona Univ. & Heriot-Watt Univ. Edinburgh
- ✓ **Le2i Research Group**
  - > Image Processing, Computer Science and Electronics
  - > Non-Classical Imaging

Motivations

Share our experience of ROS with the dev. community

- ✓ **Started in 2013**
- ✓ **2 Challenges in Computer Vision & Mobile Robotics**
  - > Introduction Modules for Education Programs
  - > Research & Development (Internships, Projects, Applications, …)
- ✓ **Unique Platform**

Outline

Learn, Teach, Search & Develop

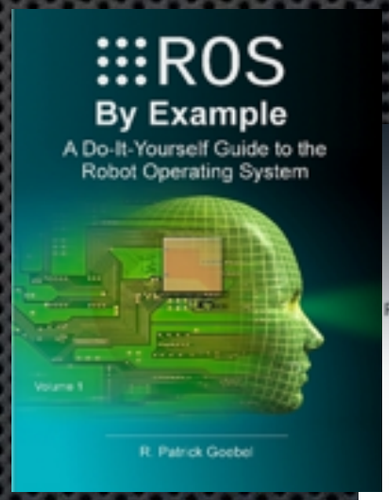
1. **Learning ROS**
2. **Education**
   - ✓ BSc & MSc Programs
3. **Research**
   - ✓ Omnidirectional Vision for Mobile Robotics
4. **Application Development**
   - ✓ 3D Vision for Precision Agriculture
5. **Conclusion**

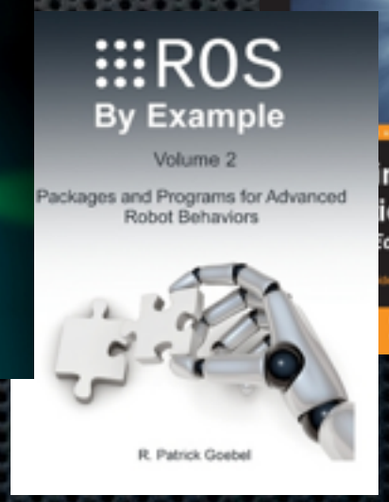
Learning

How we learn ROS

- ✓ **Official Tutorials**
  - > ROS Wiki

- ✓ **Books**
  - > ROS by Example, …





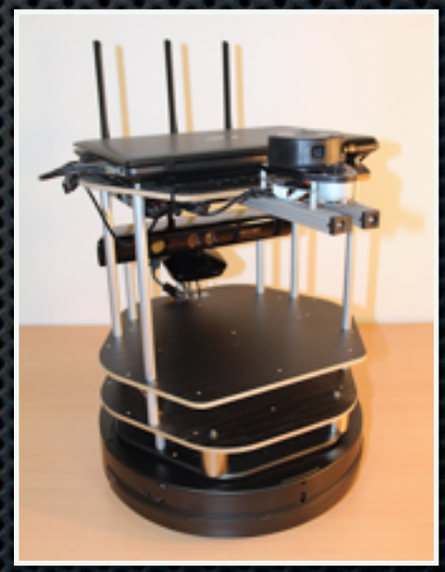
- ✓ **Workshops**
  - > GDR-Robotique, …

- ✓ **ROSCon & Shows (Innorobo, …)**

Education

How we teach ROS

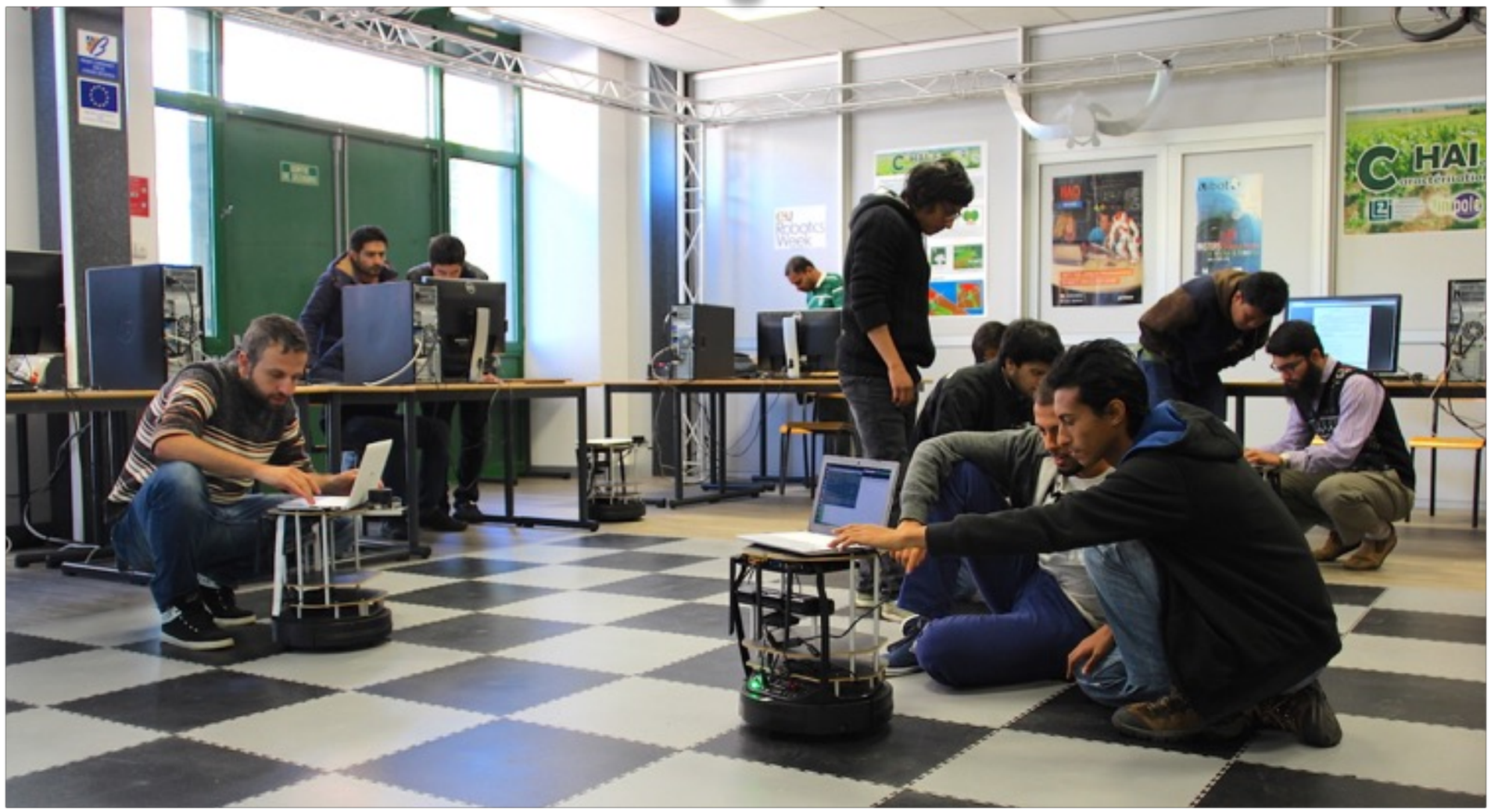
- ✓ **Intensive Training Sessions (40 hours + Practice)**
  - Tutorials
    - Introduction to the Middleware
    - Packages, Simulation & Basic Control
    - Nodes with Python Programming & Launch Files
    - C++ Programming
    - TurtleBot2
  - Technical Workshop, Summer School



Education

How we teach ROS

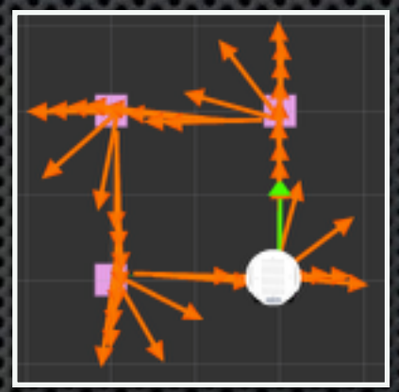
- ✓ **Project Development**
  - > Robotics Laboratory



Education

How we teach ROS

- ✓ **Project Development (~250 hours)**
  - BSc
    - Part 1 - Motion Control

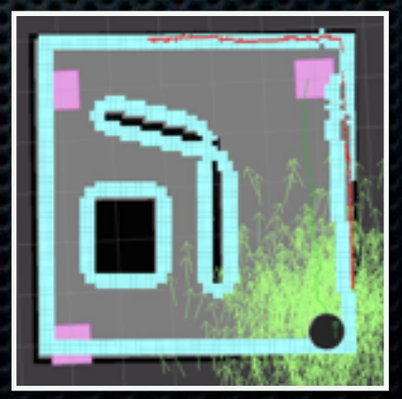


twist, odometry, move_base

- Part 2 - Planar Laser RangeFinder

RoboPeak RP-Lidar, tf, turtlebot

- Part 3 - Navigation & Localization

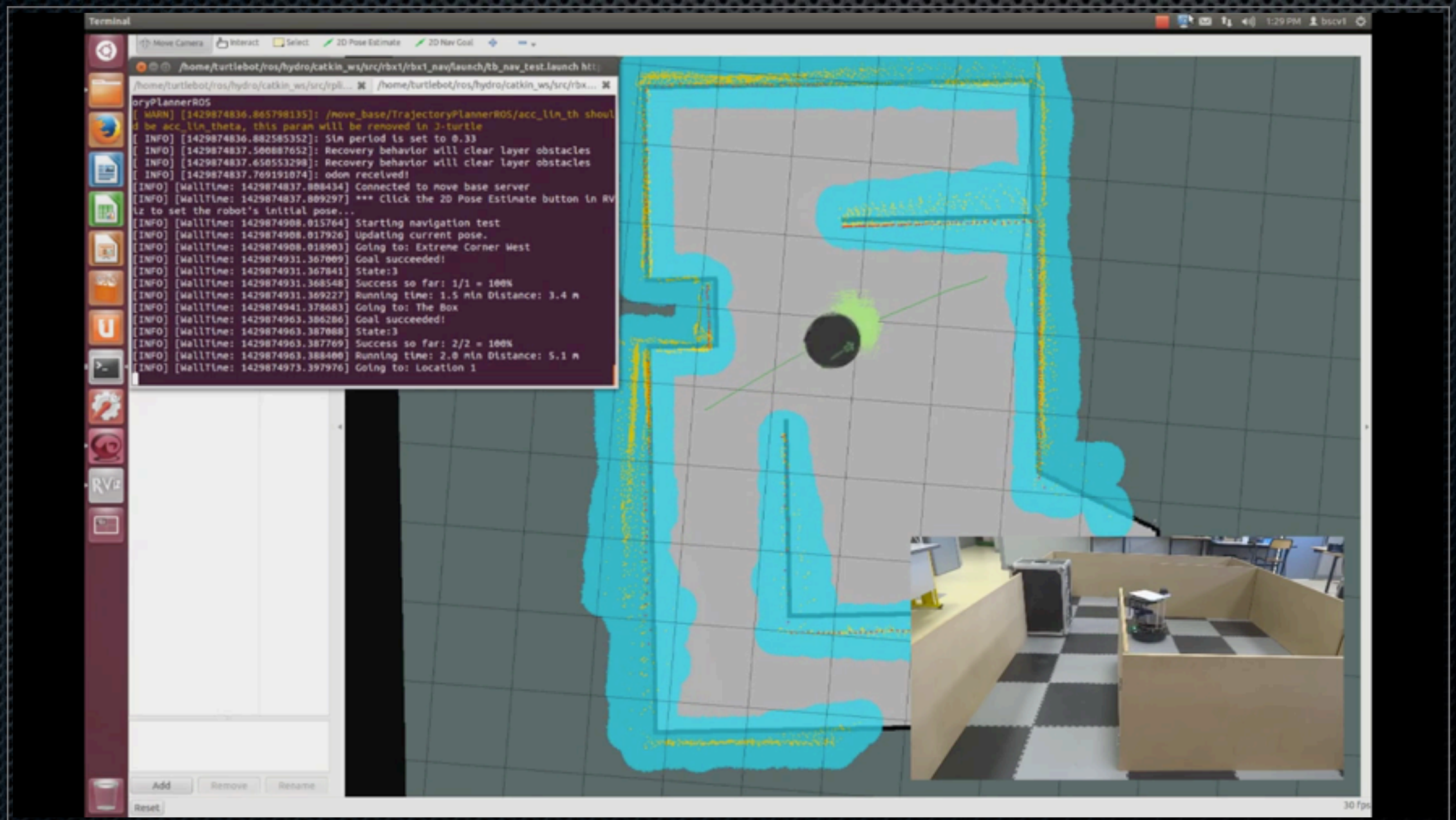


move_base, gmapping, amcl

Education

How we teach ROS

- ✓ BSc Robotics Projects - Indoor Navigation with TurtleBot2



Education

How we teach ROS

- ✓ **Project Development (~250 hours)**
  - > MSc = BSc + Computer Vision Tasks

- Patrolling with Tasks: Tag / Face Recognition, Search and Rescue, Fire Escape, …

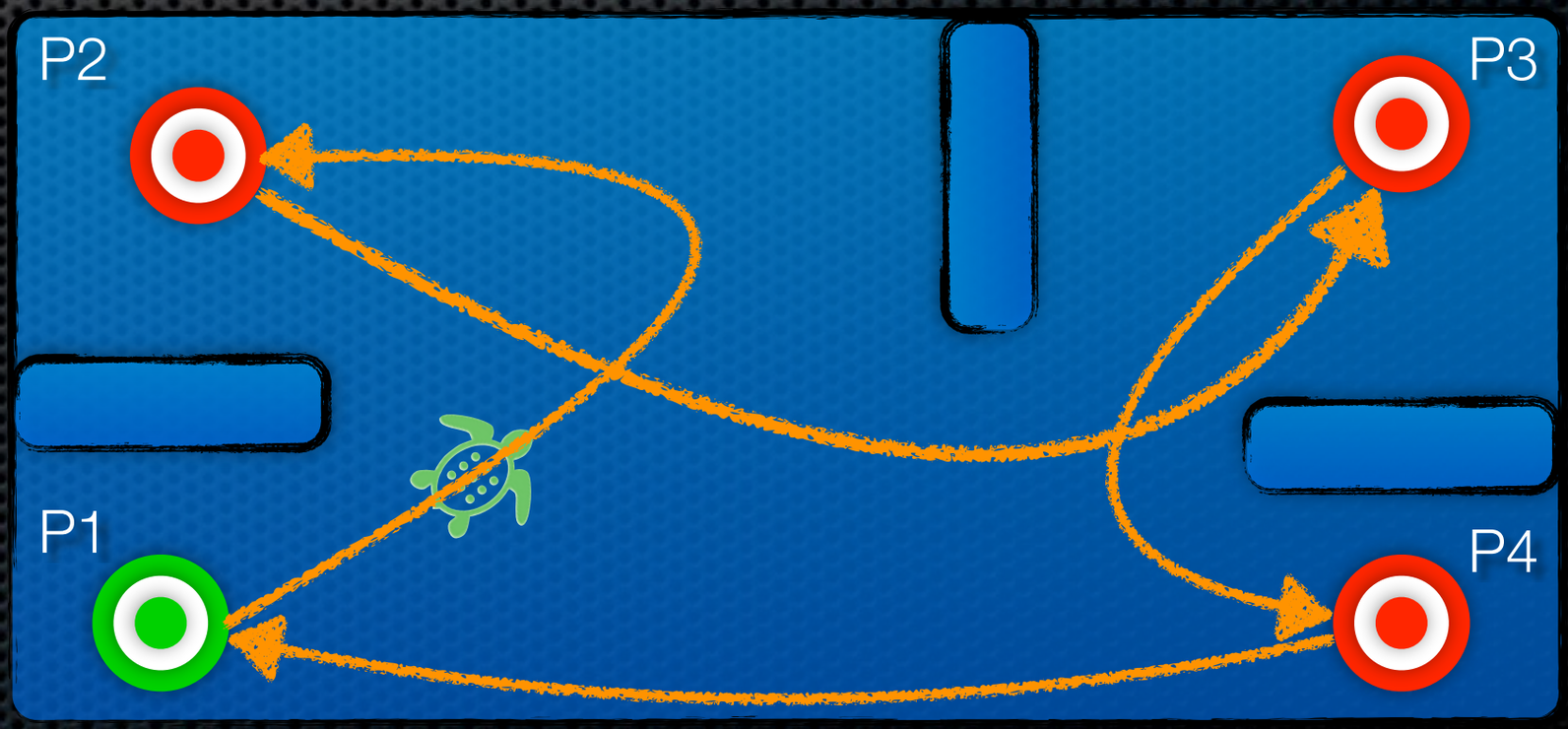
openni,

opencv,

pcl,

visp,

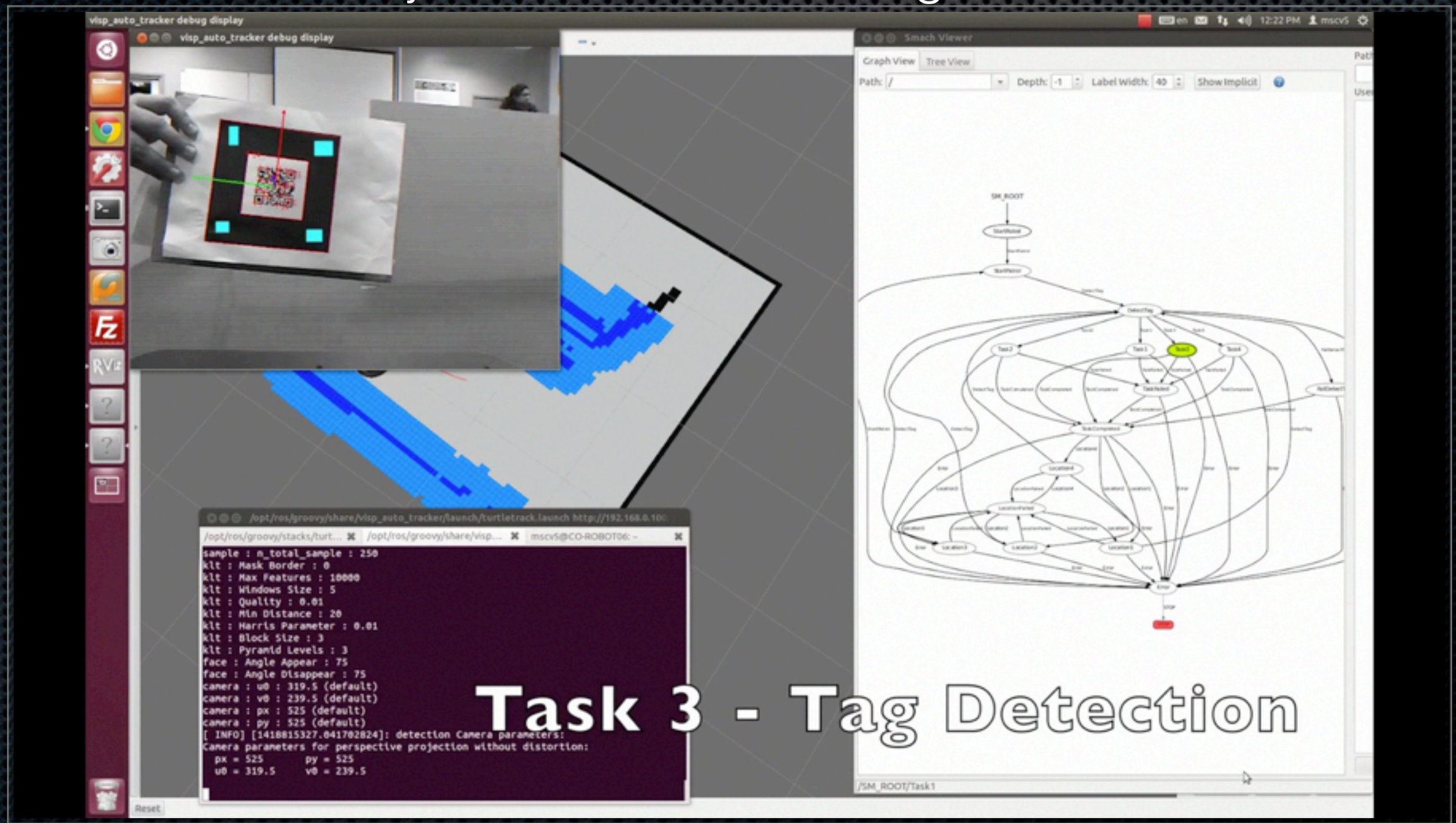
smach, …



Education

How we teach ROS

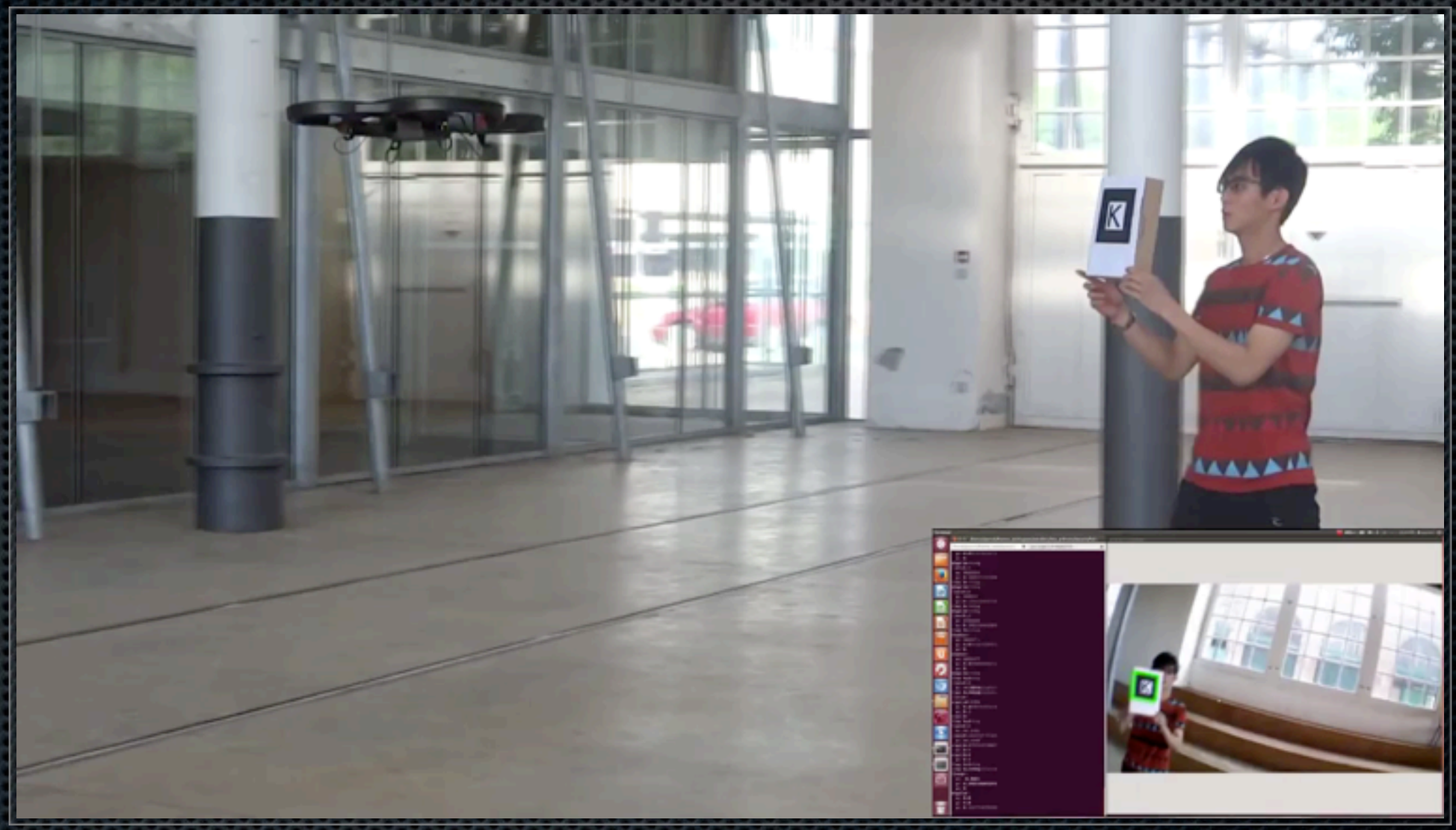
- ✓MSc Robotics Projects - Indoor Patrolling with TurtleBot2



Education

How we teach ROS

- ✓ Education Project UTP - UAV Tag Tracking



ardrone_autonomy , artoolkit

“Autonomous patrol and surveillance system using unmanned aerial vehicles”, 2015 IEEE 15th International Conference on Environment and Electrical Engineering (EEEIC), pp. 1291- 1297

Research Project

Omnidirectional Vision for Mobile Robotics

✓ **Omnidirectional Compact Sensor - Principle**

- Fisheye Lens -> Wide Angle of View ~185°
- 2 Non-Overlapping Fisheye Cameras

-> Full Panoramic Spherical View

Research Project

Omnidirectional Vision for Mobile Robotics

✓ **Omnidirectional Compact Sensor - Camera Rig**

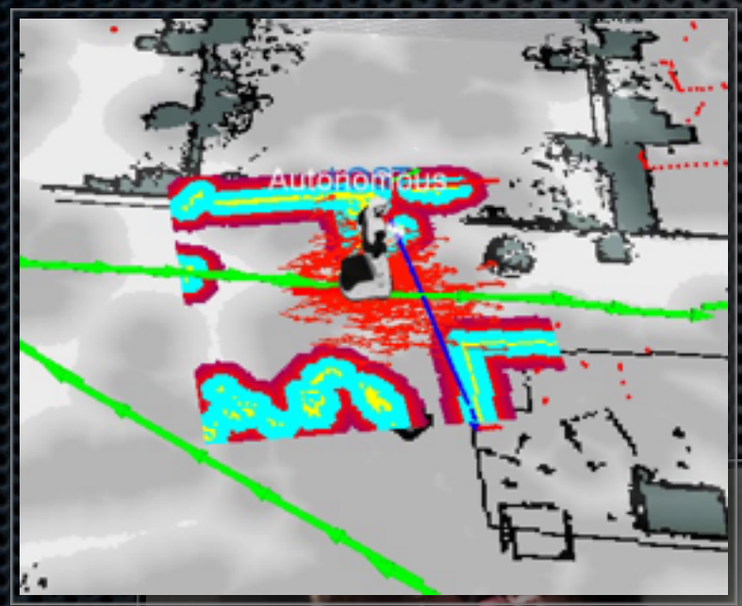
- 2 x IDS-Imaging uEye USB 3.0 Camera - *UI-3240CP*
- 2 x Fisheye Lens - *FUJINON FE185C046HA-1*

Acquisition: *ueye stereo, message_filters*
Spherical Image: *https://github.com/artivis*

Research Project

Omnidirectional Vision for Mobile Robotics

- ✓ **Omnidirectional Compact Sensor**
  - > Localization & Telepresence



PAL ROBOTICS

uB

Oculus Rift

Fish-eye cameras - 360 degrees FoV
ego-centred view

Application Development

3D Vision for Precision Agriculture

- ✓Burgundy Viticulture

  -> Sustainable Spray Application of Phytosanitary Products

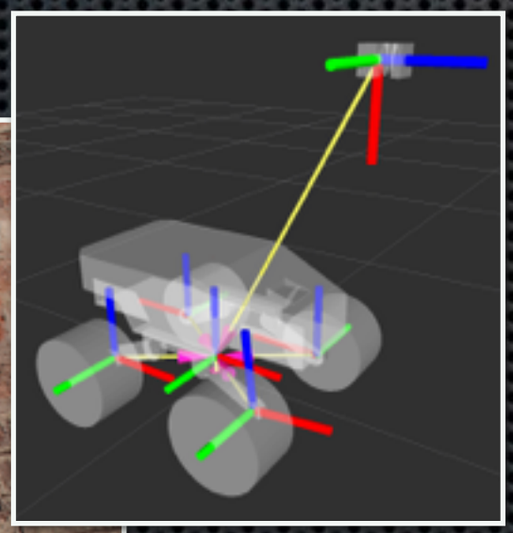
- ✓Adapt Amount of Applied Products w/r Leaf Density of the Vineyard Rows

Application Development

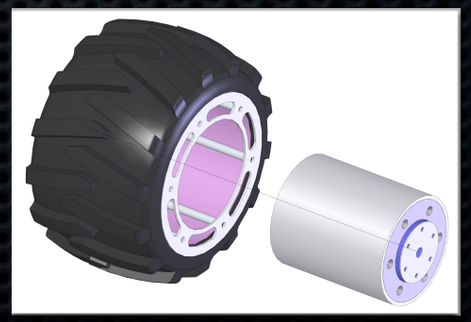
3D Vision for Precision Agriculture

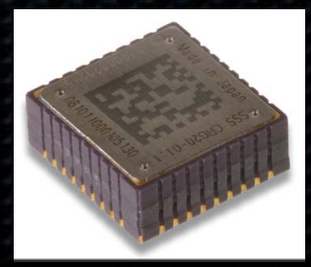
✓Prototype for 3D Vineyard Canopy Analysis

Robotnik SUMMIT XL



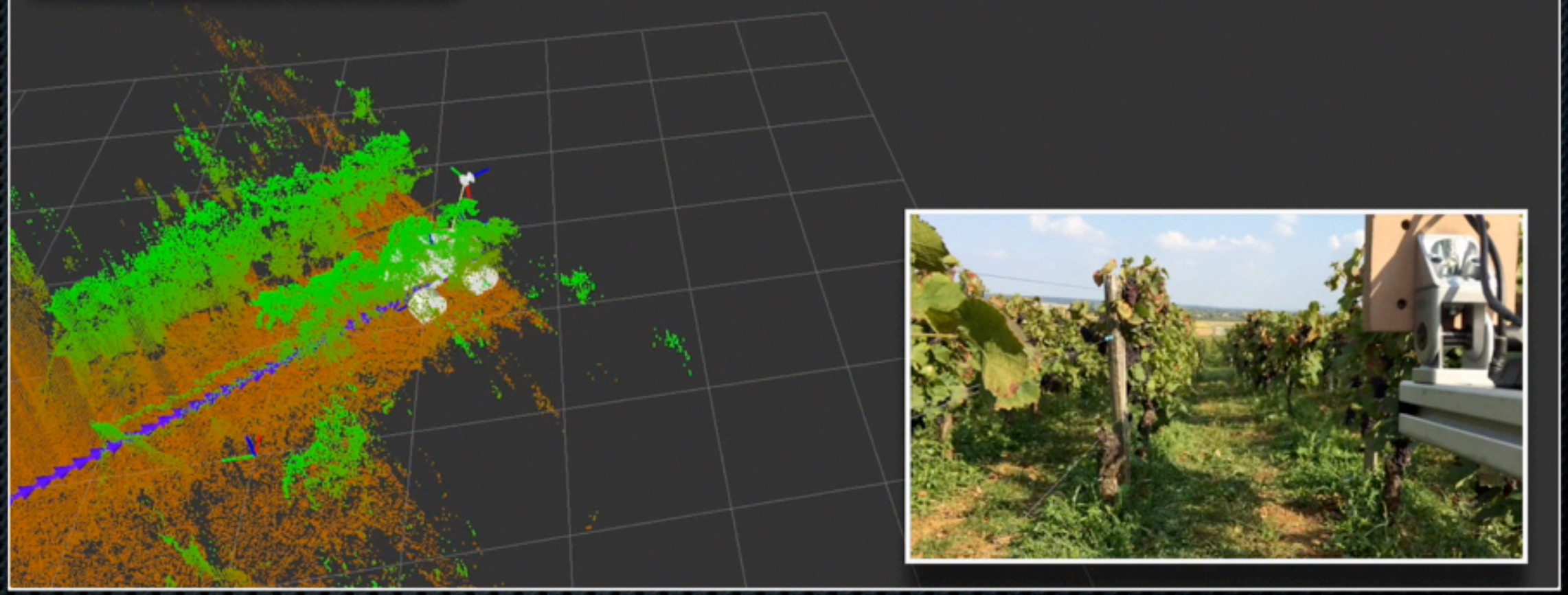
- LiDAR Sensor
  - ✓ HOKUYO UTM-30-LX
- Odometry
  - ✓ 4 Wheel Encoders
- Gyroscope
  - ✓ CRG20 Silicon Sensing





Application Development

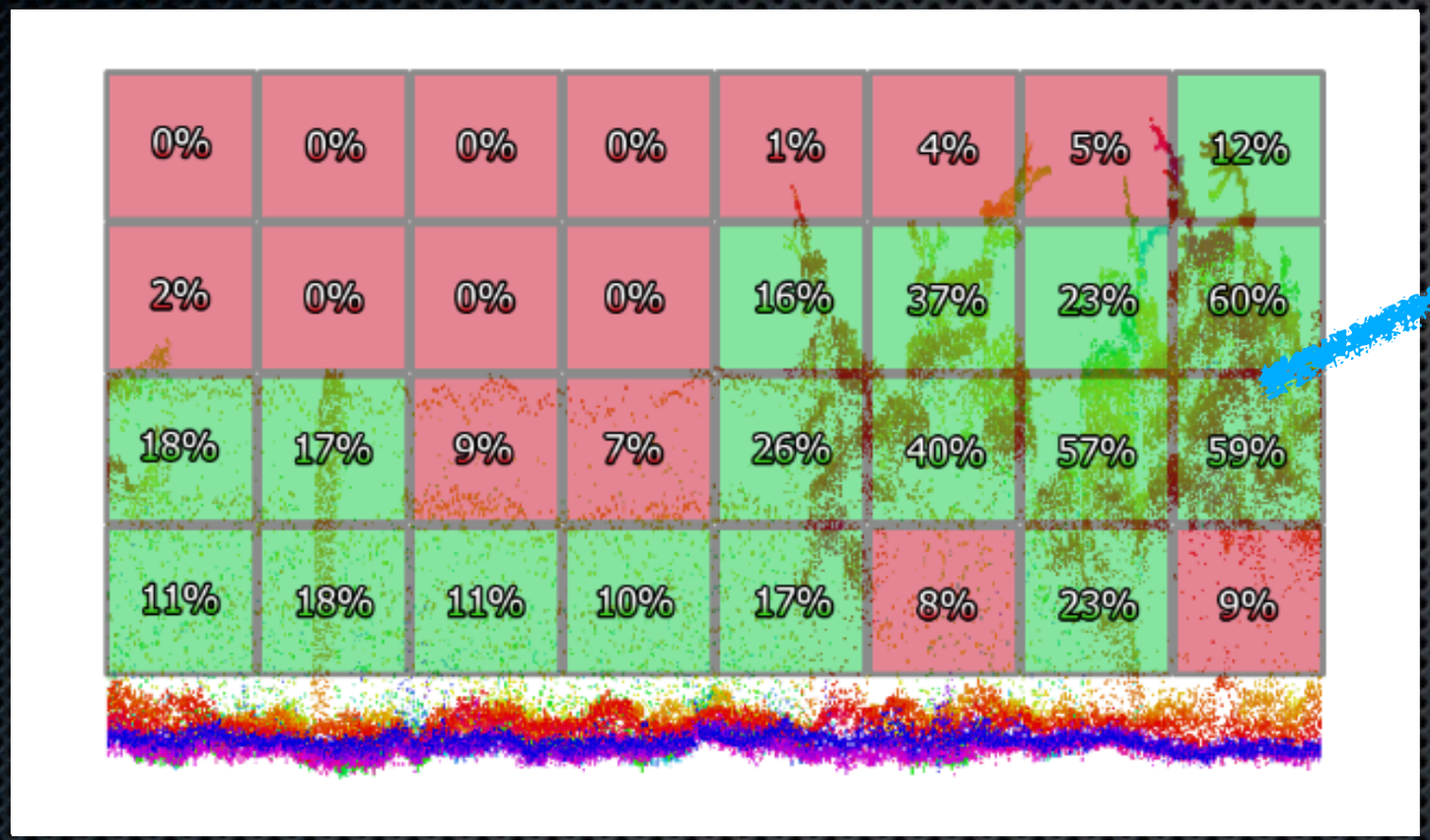
3D Vision for Precision Agriculture



summit_xl, tf, hokuyo_node, laser_pipeline

Application Development

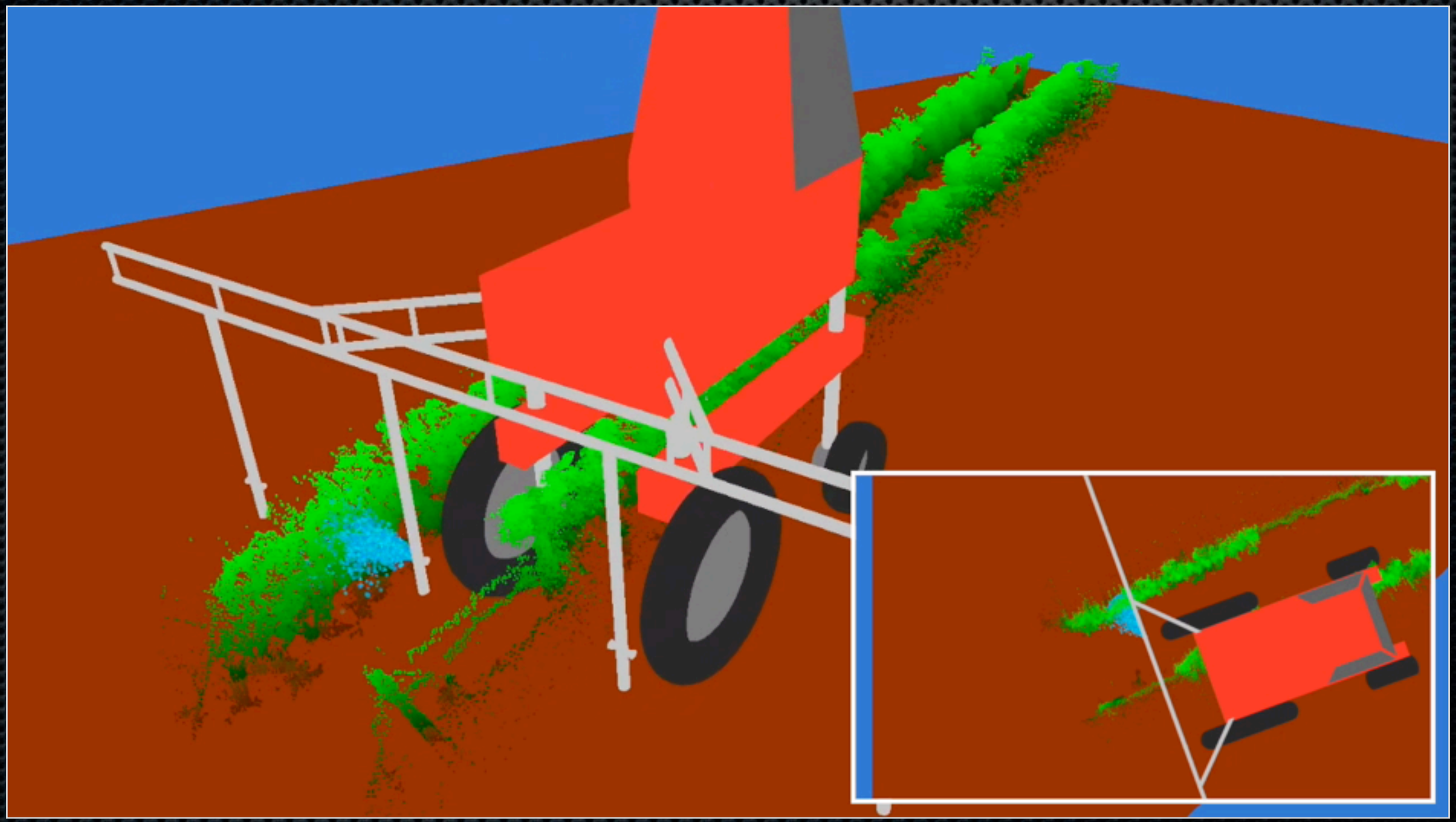
3D Vision for Precision Agriculture



laser_assembler, laserscan2pointcloud2, pcl

Application Development

3D Vision for Precision Agriculture



Conclusion

ROS for Education and Applied Research

- ✓ **How to use ROS from scratch ?**
  - > Training & Networking
  - > Practice -> TurtleBot2
- ✓ **ROSified Hardware**
- ✓ **ROS for Instrumentation**
  - > OpenSource Acquisition & Processing Platform

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