

Agricultural Robotics with ROS@Bosch

Deepfield Robotics
A Bosch Start-Up Company





ROS

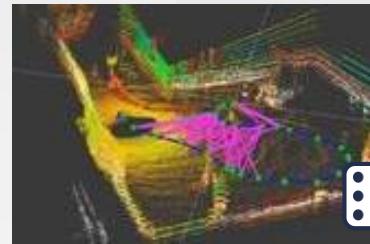


Collaborative Robotics
Technologies
CR/RTC1.1-NA

ROS



ROS



SLAM
CR/AEG

ROS

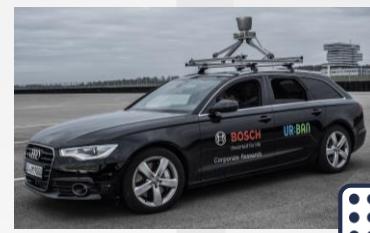


ROS



AutoBod
BEG, NuP

ROS



CR/AEV
CR/RTC1.5-NA

ROS



CC/PJ-FA
CC/ESA-NA
CC/PJ-AA

ROS



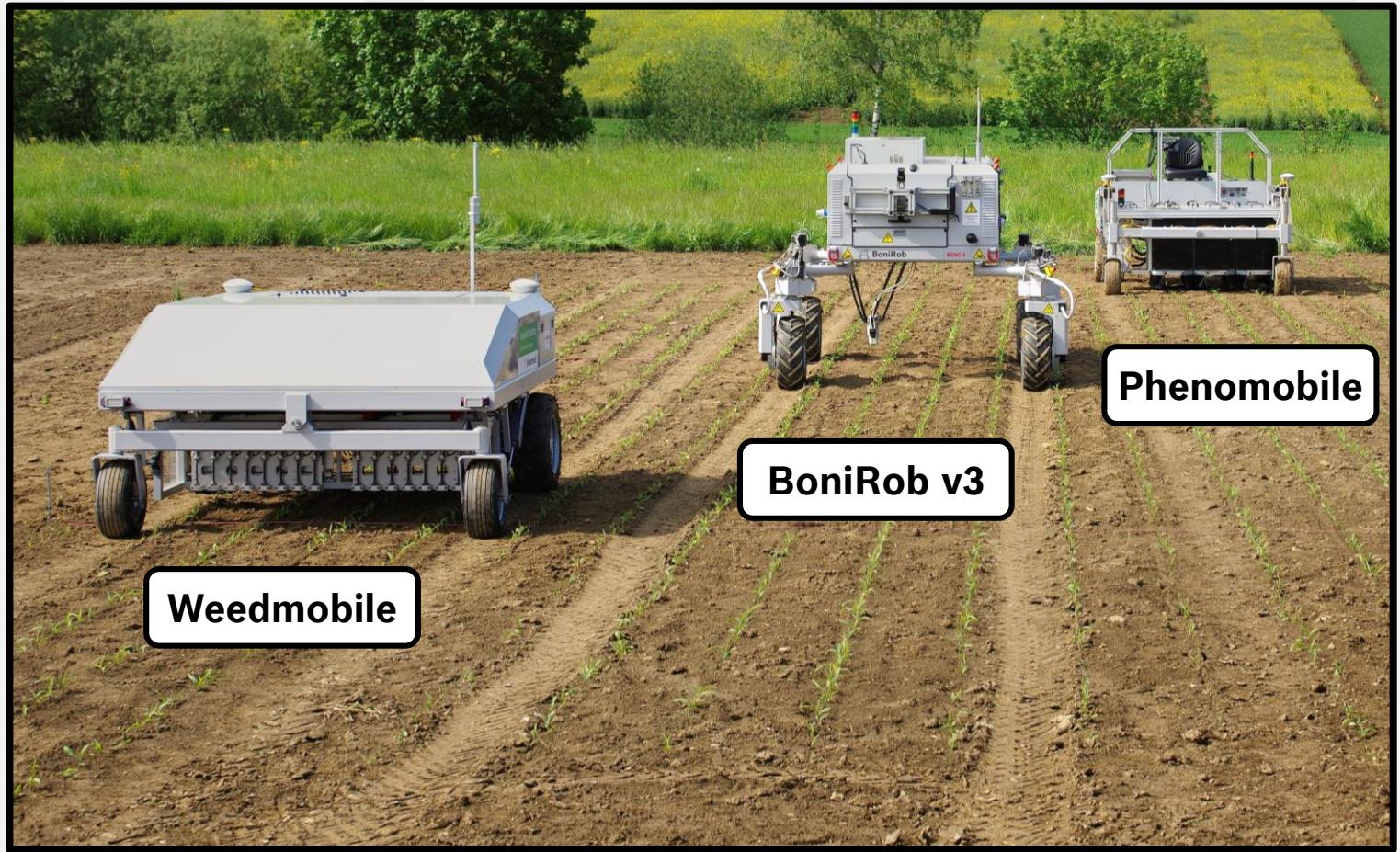
Intelligent transport
assistant
CR/AEY2

ROS

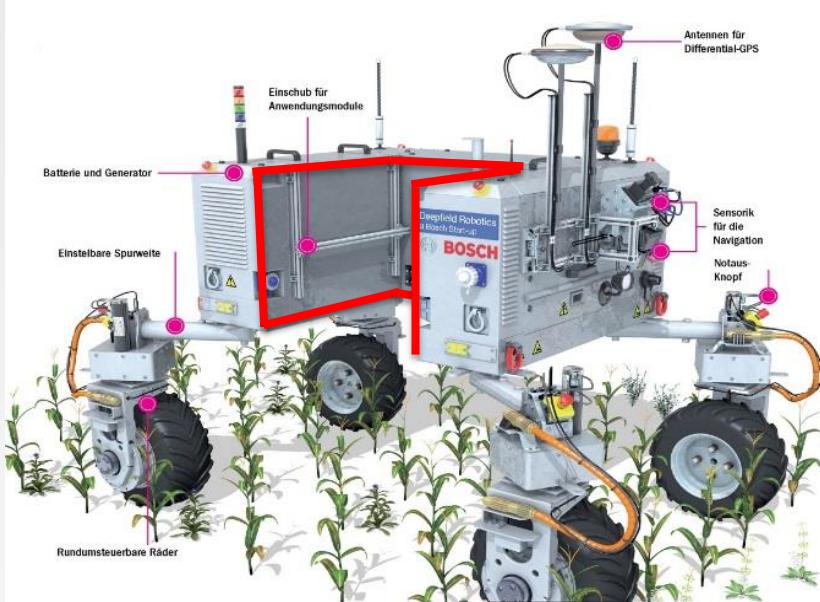
Sensor & Radar
Development
CC-DA/ESI3

ROS

**BOSCH**



 **BOSCH**



© Brian Sipple, Udo Flohr MiT Tech Review



Precision-Spraying-App



Phenotyping-App



Penetrometer-App

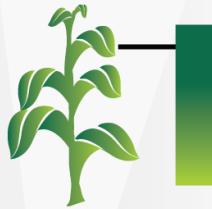


Weeding-App

BOSCH



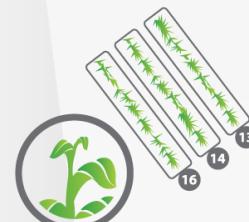
 **BOSCH**



Colour



Canopy analysis



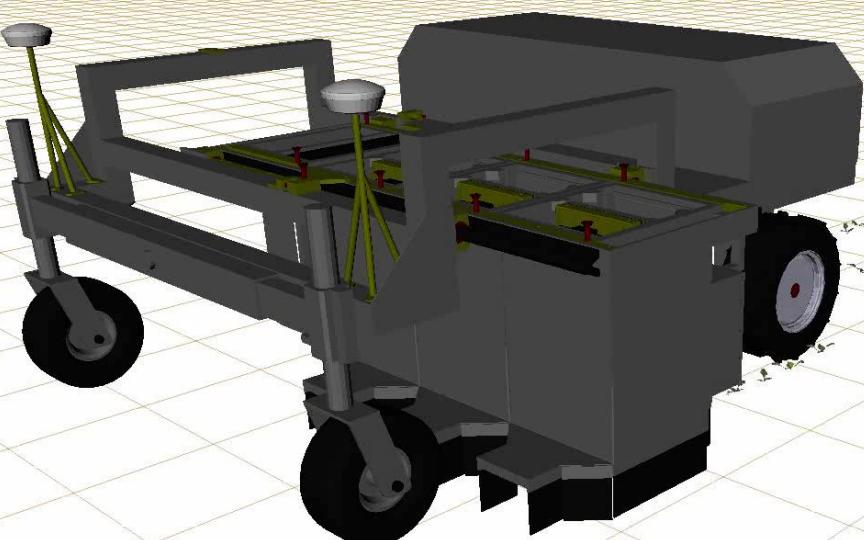
Plant counting



Plant height



Track weather



BOSCH

Phenomobile

JAI

Kinect2

Control &
diagnostics
Tablet

Smart relay

Joystick

Motor

Safety PLC

sanity
check
Camera App
x3

Main control and
coordination

Drive ECU

Deepfield

sanity
check

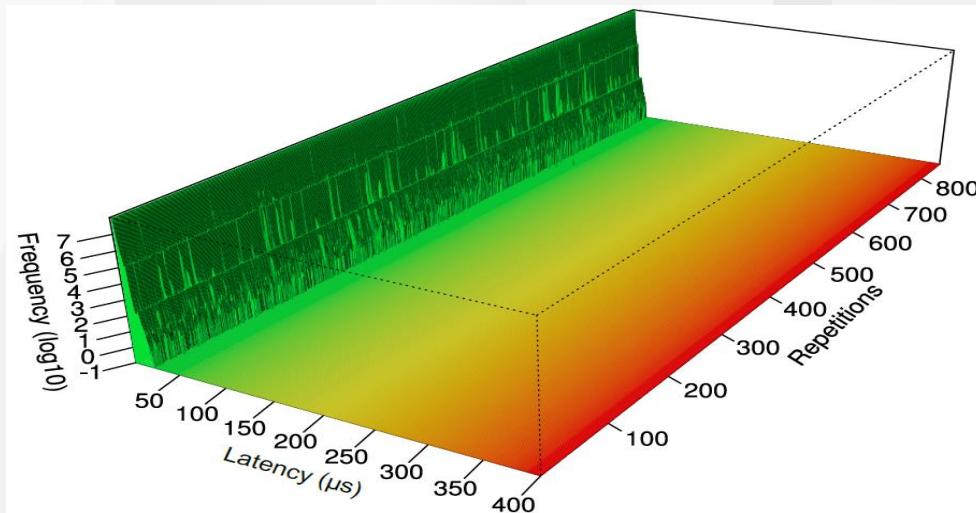
BagBunker

Plant detection
and processing

Deepfield
Cloud

Real-time Drive ECU

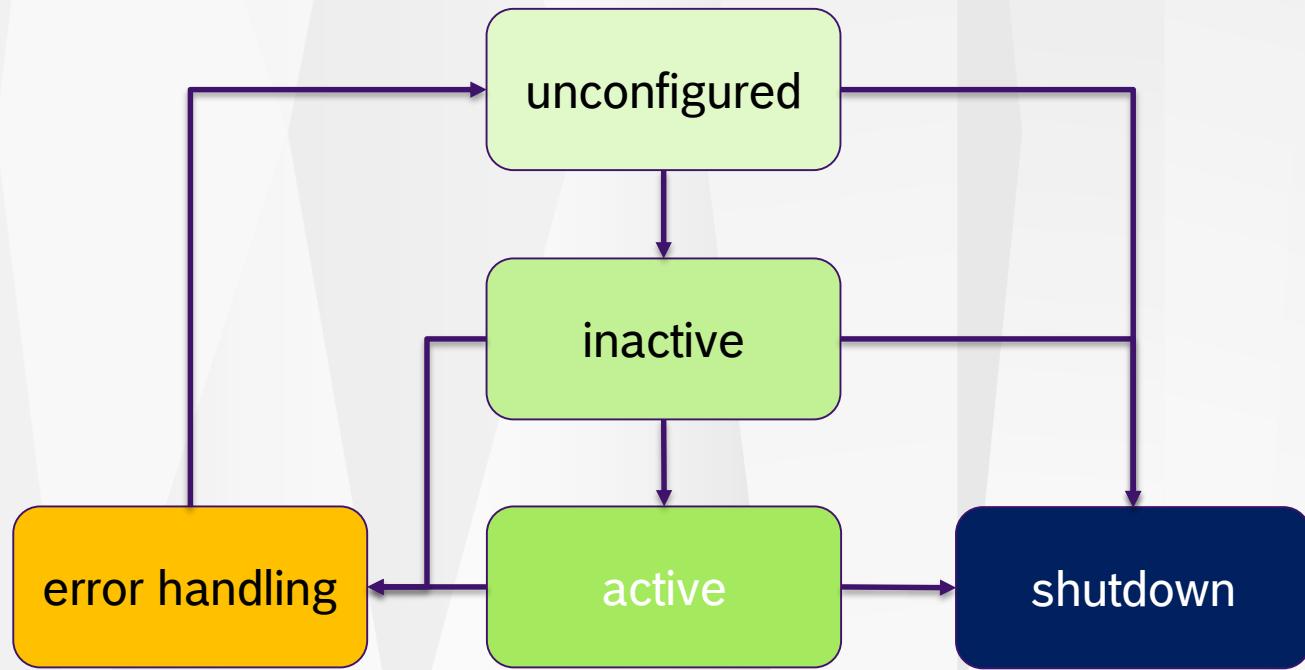
- Requirement: Absolutely real-time loops and asynchronous monitoring of interrupts
- Solution: Odroid XU4 with Linux RT_Preempt patch (tradeoff is throughput)
 - How real-time and reliable is it?
- The OSADL QA farm runs a large number of long-term tests using different HW platforms with a stable Linux 3.12-based real-time kernel (including RT PREEMPT)
 - Monitored stress tests to detect: kernel crashes, memory leaks, driver misbehavior, **unsatisfying worst-case latency**
 - ▶ <https://www.osadl.org/QA-Farm-Realtime.qa-farm-about.0.html>
 - ▶ 1 year long-term monitoring without outliers



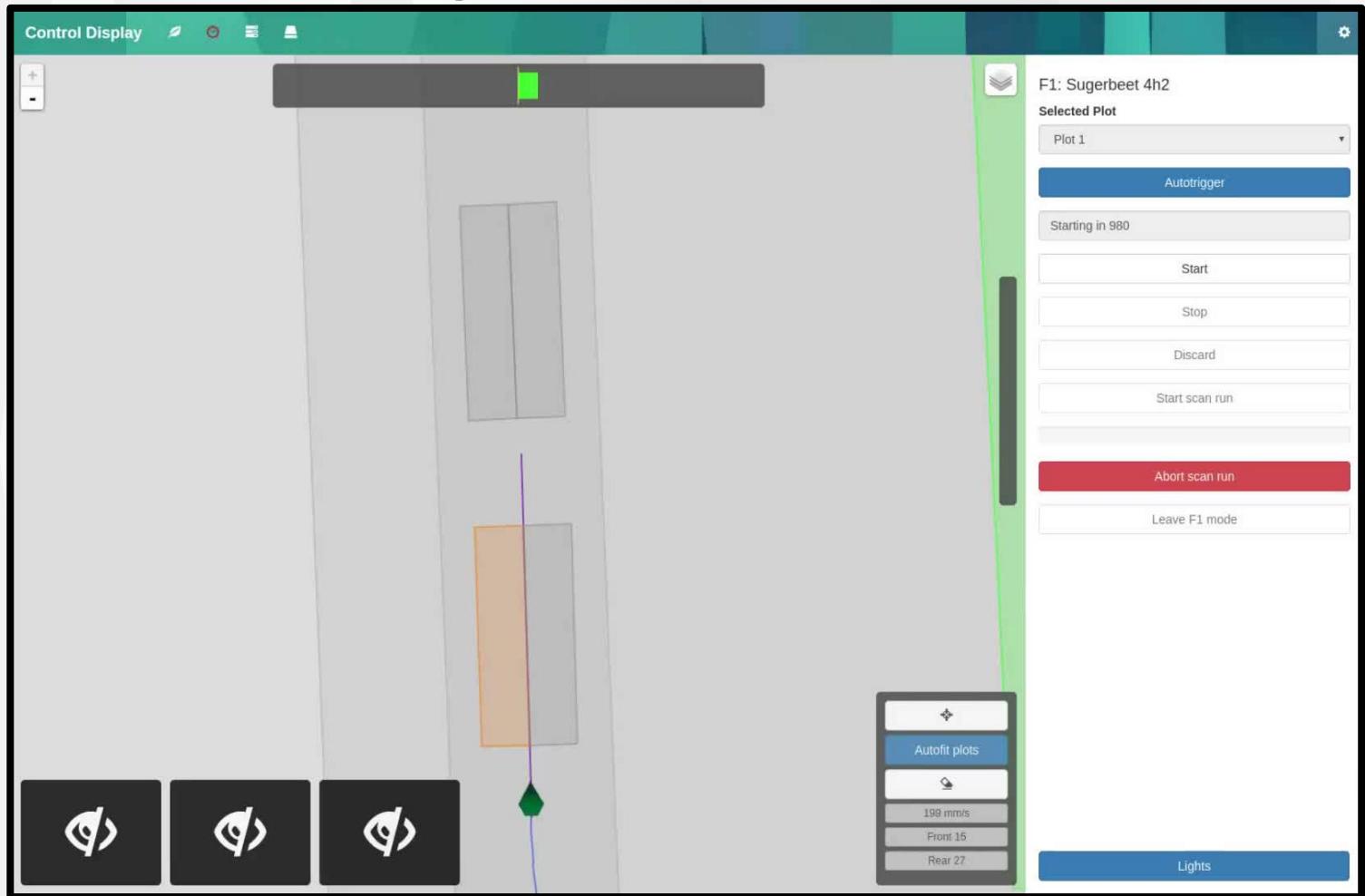
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Lifecycle management

- Goal: Allow controllability and increase visibility of node operational state
- Our ROS1 implementation is based on ROS2 “managed node” proposal
- We use this to control our cameras and lighting system
- Open Source release imminent



Control and Diagnostics

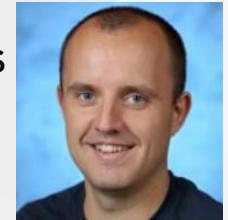


TERNARIS

BOSCH

Bagbunker

More about this
in the following
talk



BagBunker

Sign out pad1pal

Filters

Name	substring	parzelle01
MDS	startswith	
Size	>=	
Comment	substring	
Tag	contains	as20150818 x F1 x
Starttime	>=	
Endtime	<=	
Duration	>=	
Message type	substring	
Topic	substring	
Robot	substring	
Use Case	substring	

apply filter reset filters

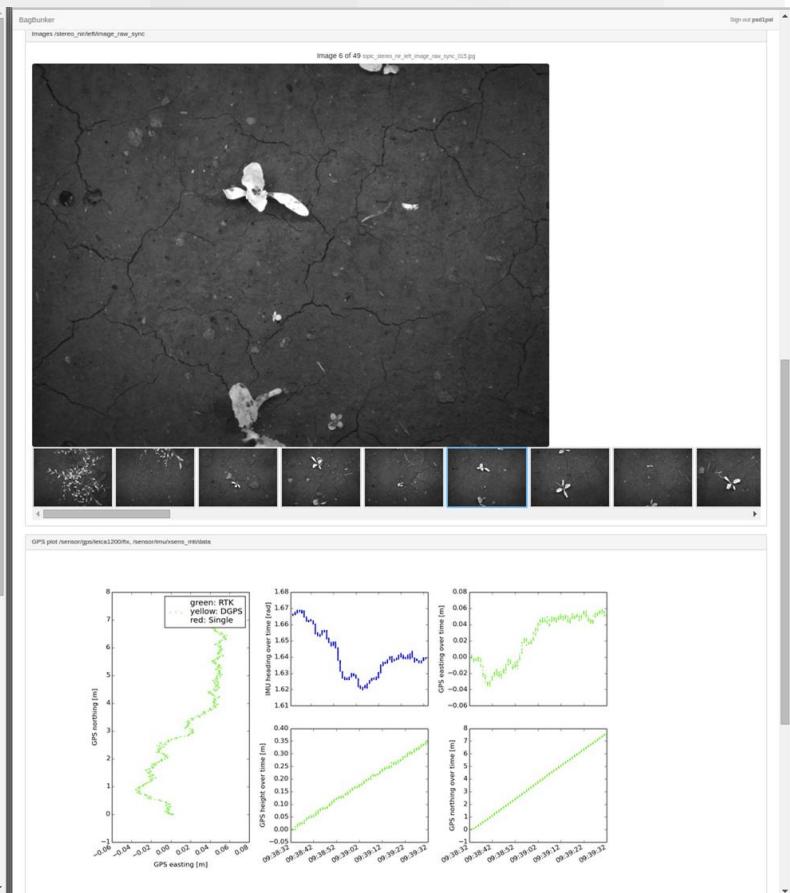
Summary

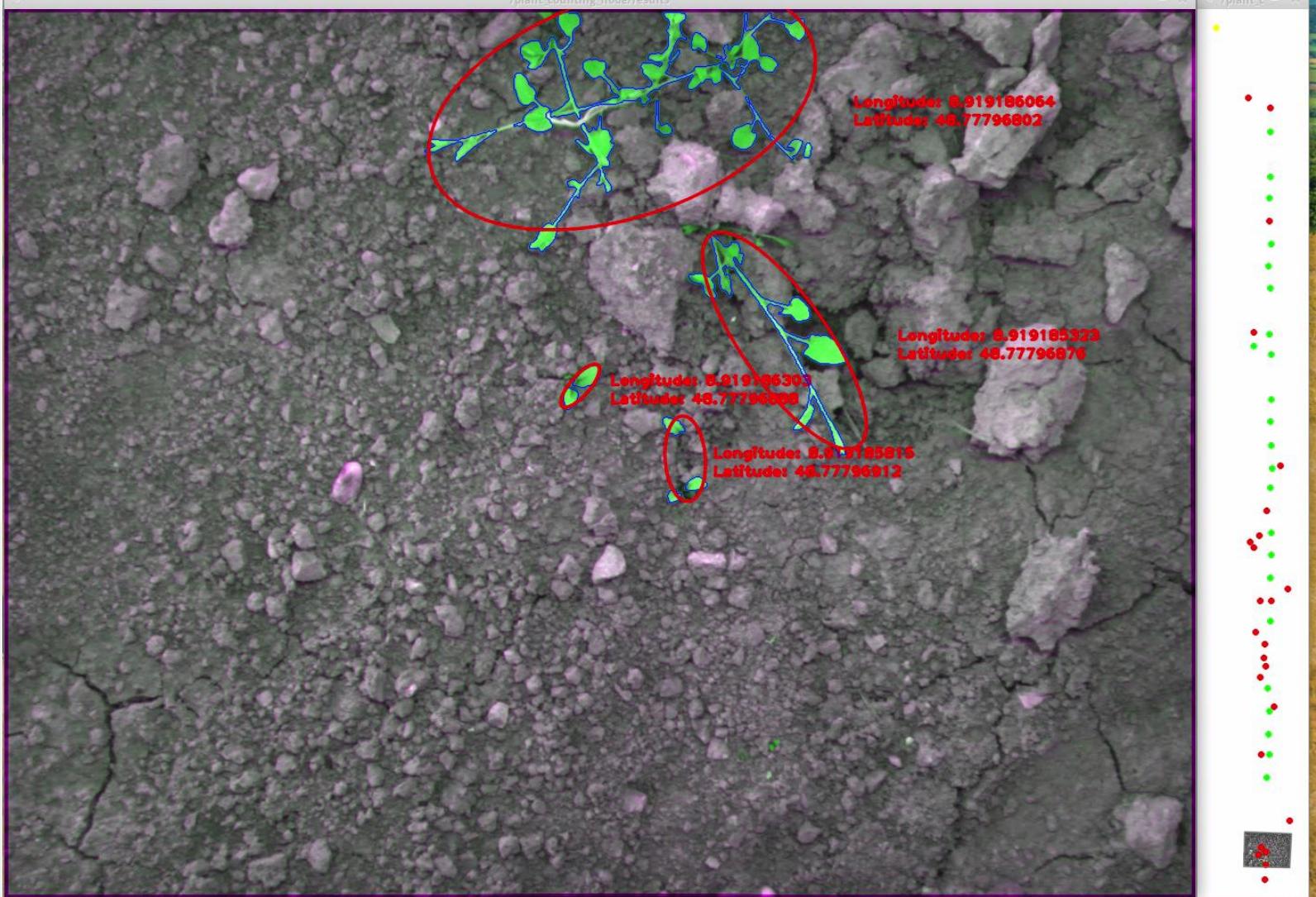
Fileset Count	File Count	Total Size	Duration (s)
12	12	27.51 GB	607.798797

Datasets (12 found)

bulk operations

Name	Abbr.	MDS	# files	Status	# comments	Tags	Starttime	Endtime	Duration (s)	Robot	Use Case
zr_as20150818_day12_jai_parzelle01_2015-09-04-09-38-32	IS89a97	2.59 GB	1	0	0	F1 as20150818	2015-09-04 11:38:32	2015-09-04 11:39:33	60.744773	BoniRobV3-	phenotyping
zr_as20150818_day11_jai_parzelle01_2015-09-03-17-26-03	83f3878	2.40 GB	1	0	0	F1 as20150818	2015-09-03 07:26:03	2015-09-03 07:26:59	55.999921	BoniRobV3-	phenotyping
zr_as20150818_day10_jai_parzelle01_2015-09-02-15-52-00	4ad6af8	2.06 GB	1	0	0	F1 as20150818	2015-09-02 05:52:00	2015-09-02 05:52:49	48.850607	BoniRobV3-	phenotyping

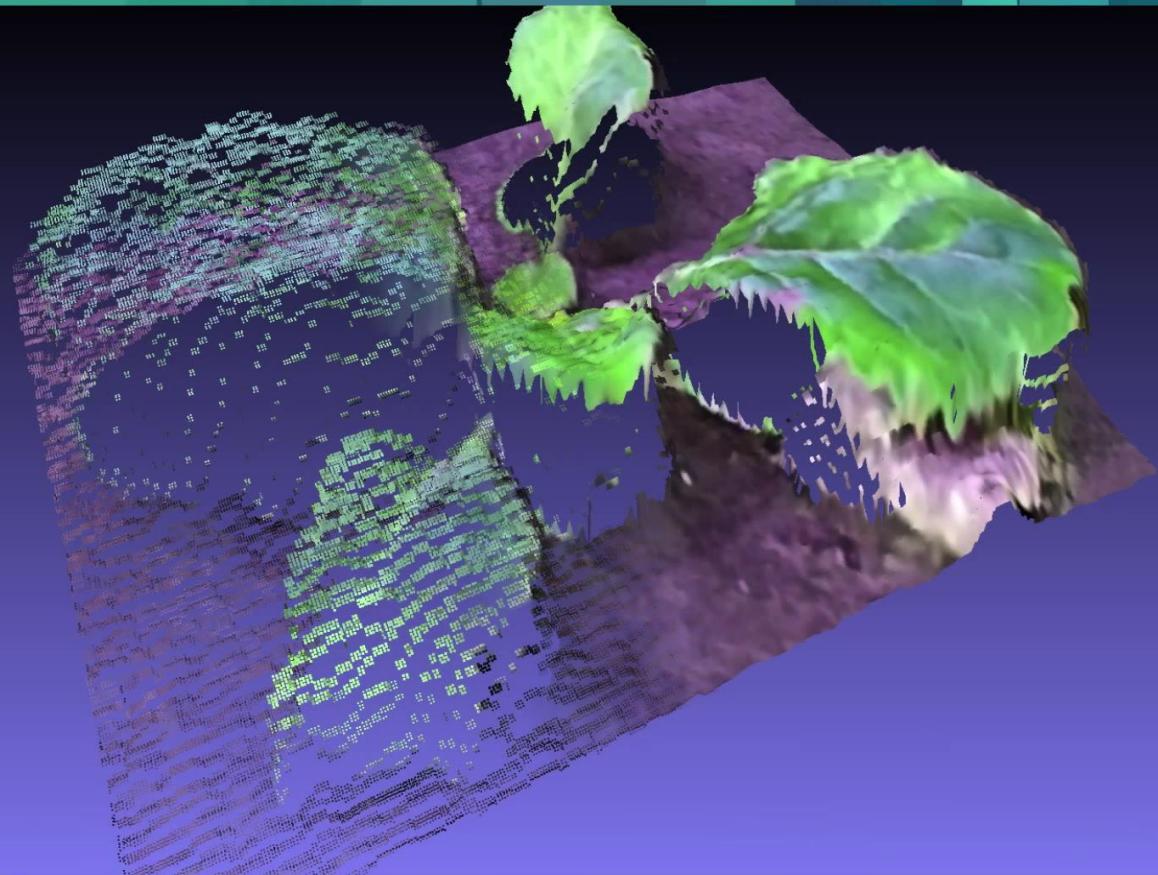




BOSCH

Series

- 2016 - 201
- 2016 - 202
- 2016 - 203
- 2016 - 204
- 2016 - 205
- 2016 - 206
- 2016 - 207
- 2016 - 208
- 2016 - 209



TERNARIS

strube
The Seed. Est. 1877

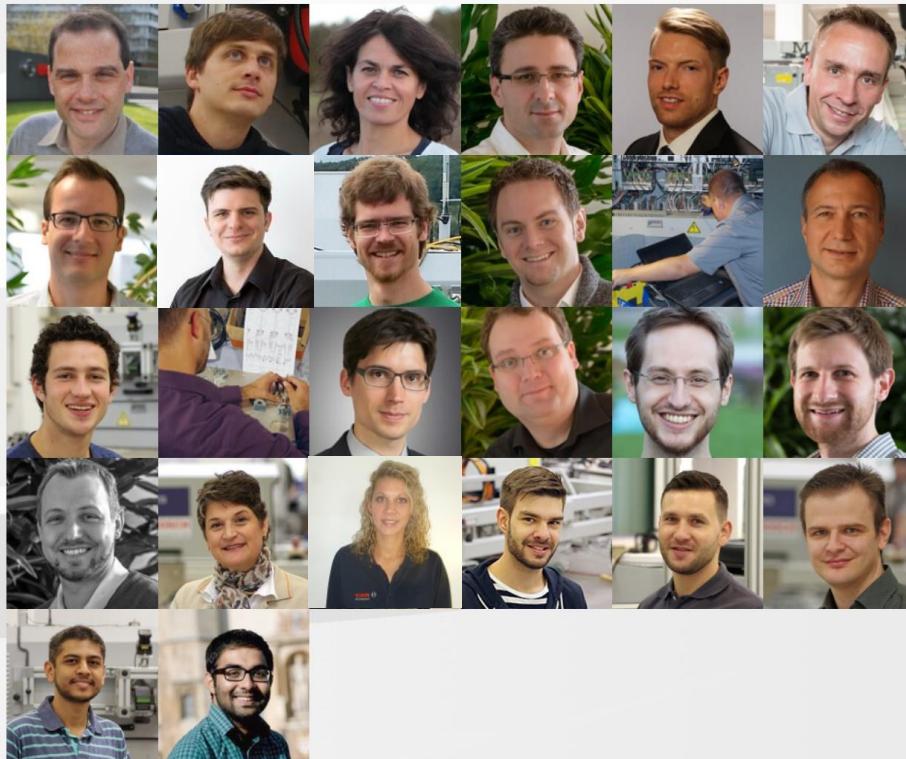
 **BOSCH**

Future (Technical)

- ROS 2.0
- Offline processing – We need deterministic processing through nodes & including nodelet startup
- Continuous integration requiring quality assurance from bagfiles to the website
- Accurate timing for sensors. Changing from `ros::Time::now()` to `ros::Time::the_time_the_sensor_reading_was_taken()`



www.deepfield-robotics.com



Alumni



Ternaris



Bosch Corporate Research

