



PANTHER

Powerful Autonomous eNTity High-End Robot

About me

Raffaello Bonghi, PhD



- ▶ Automation and robotic engineer
- ▶ Education:
 - ▶ BSc in Automation and System Engineering (University of Rome, "La Sapienza" 2006 - 2009)
Thesis: Design and Realization of an autonomous mobile platform
 - ▶ MSc in System and Control Engineering (University of Rome "La Sapienza" 2009 - 2012)
Thesis: An autonomous mobile platform in an "Augmented reality" environment
 - ▶ PhD in Automation and Operative Research 2012-2016 (University of Rome "La Sapienza" - Italy & L2S, Supélec, Université Paris Sud XI - France)
Thesis: Non linear sampled-data for mobile robotics
- ▶ Experience:
 - ▶ **NTT DATA** (March 2017 - Now)
 1. Optimization and IoT problems for Energy environments
 2. Automotive and self drive vehicles
 - ▶ **Over S.r.L.** (November 2016 - March 2017)
Embedded system engineer for energy meter
 - ▶ **Italian Institute of Technology IIT** (November 2014 - March 2015)
Internship about Control and friction reduction on humanoid robot iCub

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 http://rnext.it

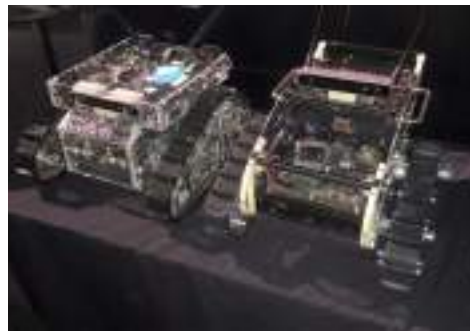
Outline

- ▶ About me
- ▶ Events
- ▶ Panther project
 - ▶ Mechanics
 - ▶ Electronics
 - ▶ NVIDIA Jetson TX2
- ▶ ROS
 - ▶ Navigation
 - ▶ Autonomous navigation
 - ▶ RTABMAP
 - ▶ cartographer



Events - NVIDIA GTC 2015 & 2016

San Jose - California (U.S.A.)



- ▶ Show Dude (2015/2016) with:
 - ▶ Jetson TK1
 - ▶ RGBD sensor
 - ▶ Motor controller
- ▶ Show Panther (2016) in early release

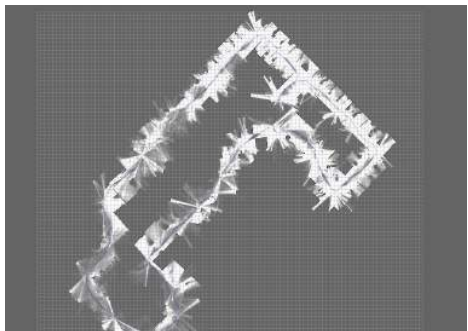
Events -Japan Tokyo - August 2016

NVIDIA Meet-up & Maker Faire Tokyo 2016

- ▶ My first trip in Japan ^_^
- ▶ During the Meet-up:
 - ▶ Introduction ROS
 - ▶ Dude
 - ▶ Panther



Events- GTC Europe 2017 Munich 10-12 October



- ▶ Presentation Poster on: “robot augmented reality”
- ▶ Panther showed on NVIDIA Booth
 - ▶ Autonomous navigation
 - ▶ 3D mapping (rtabmap)
 - ▶ 2D/3D mapping (cartographer)

What is Panther?

Powerful Autonomous eNTity High-End Robot



- ▶ Panther is acronym of:
 - ▶ Powerful
 - ▶ Autonomous
 - ▶ eNTity
 - ▶ High-End
 - ▶ Robot
- ▶ Panther is an autonomous mobile robot for:
 - ▶ Autonomous navigation
 - ▶ 2D/3D reconstruction
 - ▶ Interaction
- ▶ Panther use:
 - ▶ NVIDIA Jetson TX2
 - ▶ ZED stereocamera
 - ▶ Slamtec LIDAR
- ▶ Panther is ROS enabled!



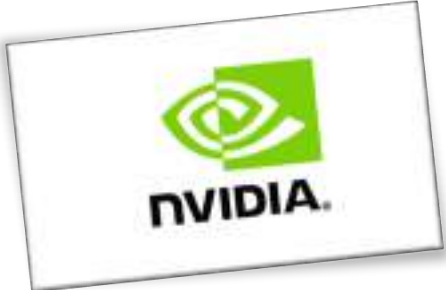
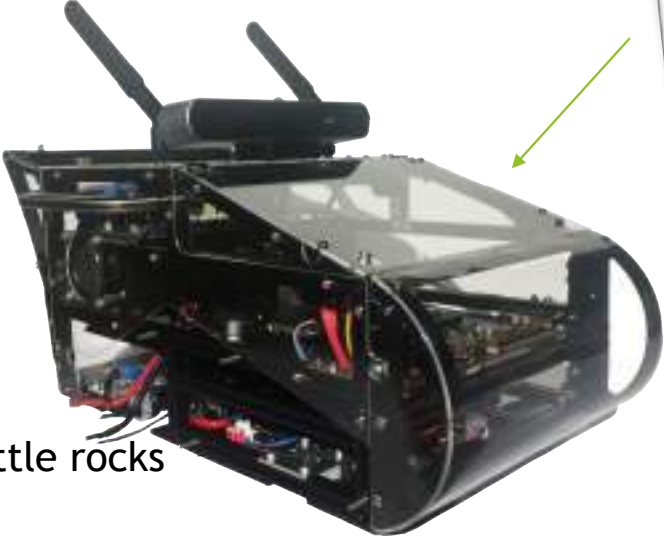
Mechanics

- ▶ Fully home made project!
- ▶ Parts:
 - ▶ 2x Tracks
 - ▶ 1x Body
- ▶ Materials:
 - ▶ Plexiglas
 - ▶ Aluminum
 - ▶ 3D printed parts



Tracks and frames

Rubber track
A lot of wheels!
Plexiglas material
3 parts perfect to climb little rocks



- NVIDIA Jetson TX2
- ZED stereocamera
- Slamec LIDAR
- IMU
- Speakers
- Roboteq motor controller



Panther upgrade 2016 -> 2017



<https://www.youtube.com/watch?v=Fnjxk0AIESU>

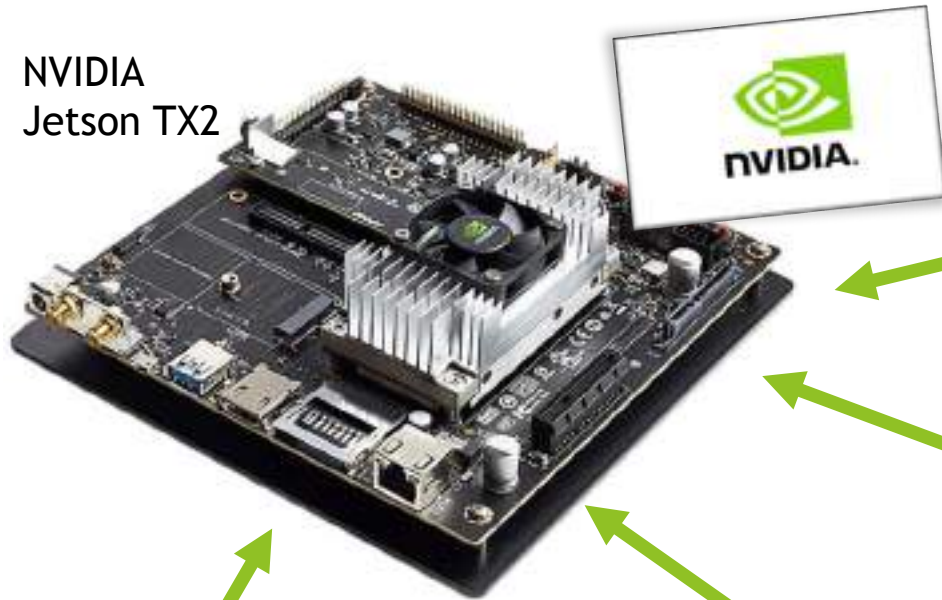
Panther @ GTC17EU



<https://www.youtube.com/watch?v=ljHqjM4LzU4>

Electronics

NVIDIA
Jetson TX2



Roboteq
DC Motor controller



SLAMTEC
LIDAR



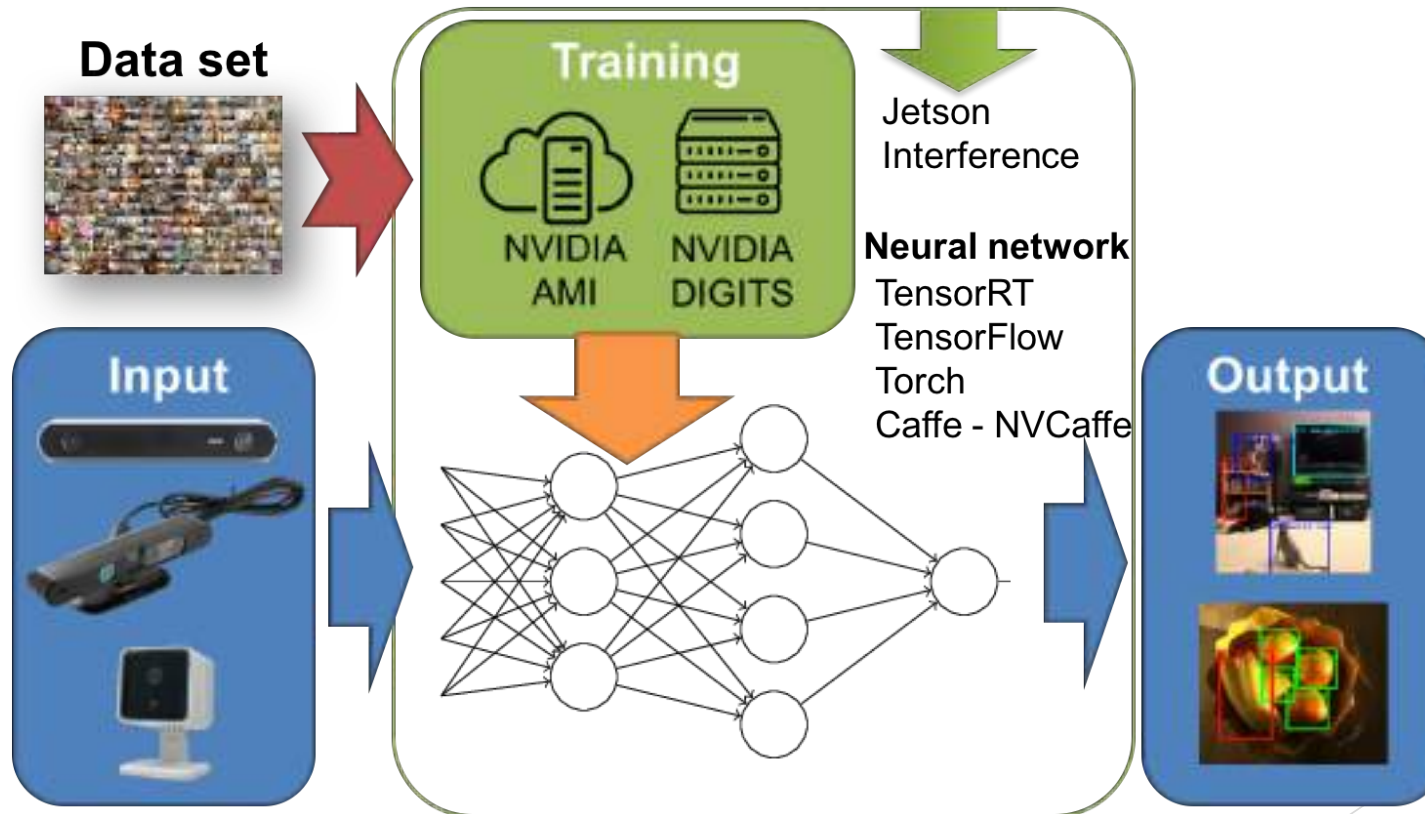
Sparkfun IMU



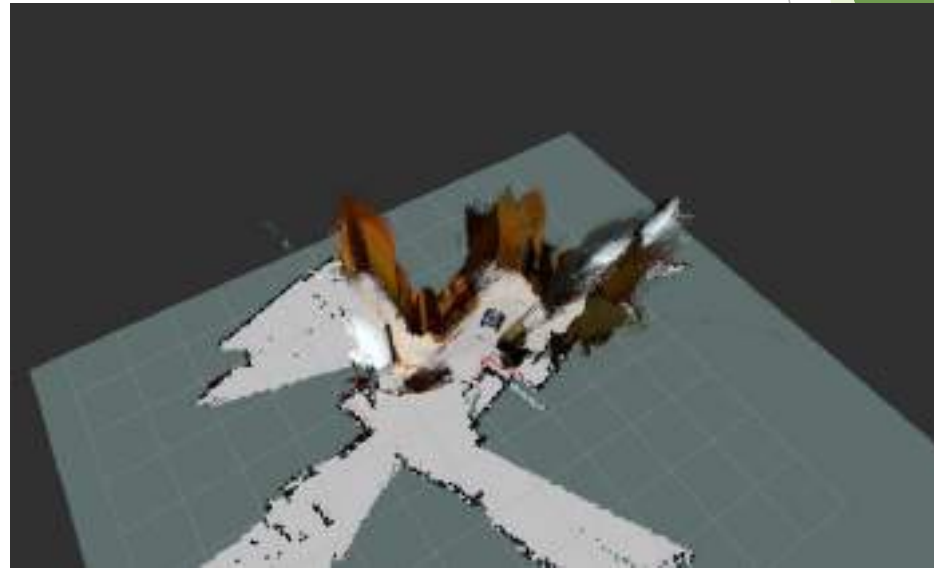
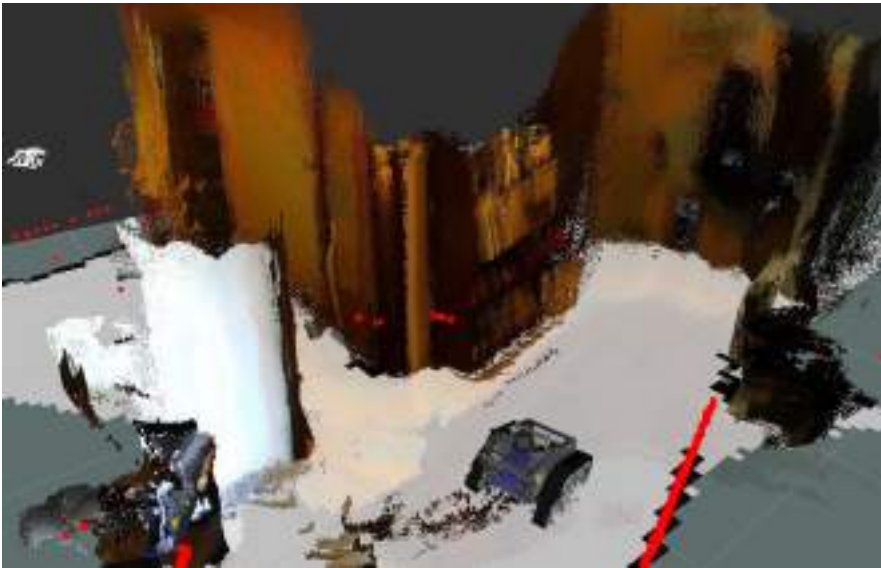
ZED Stereolabs
Stereocamera



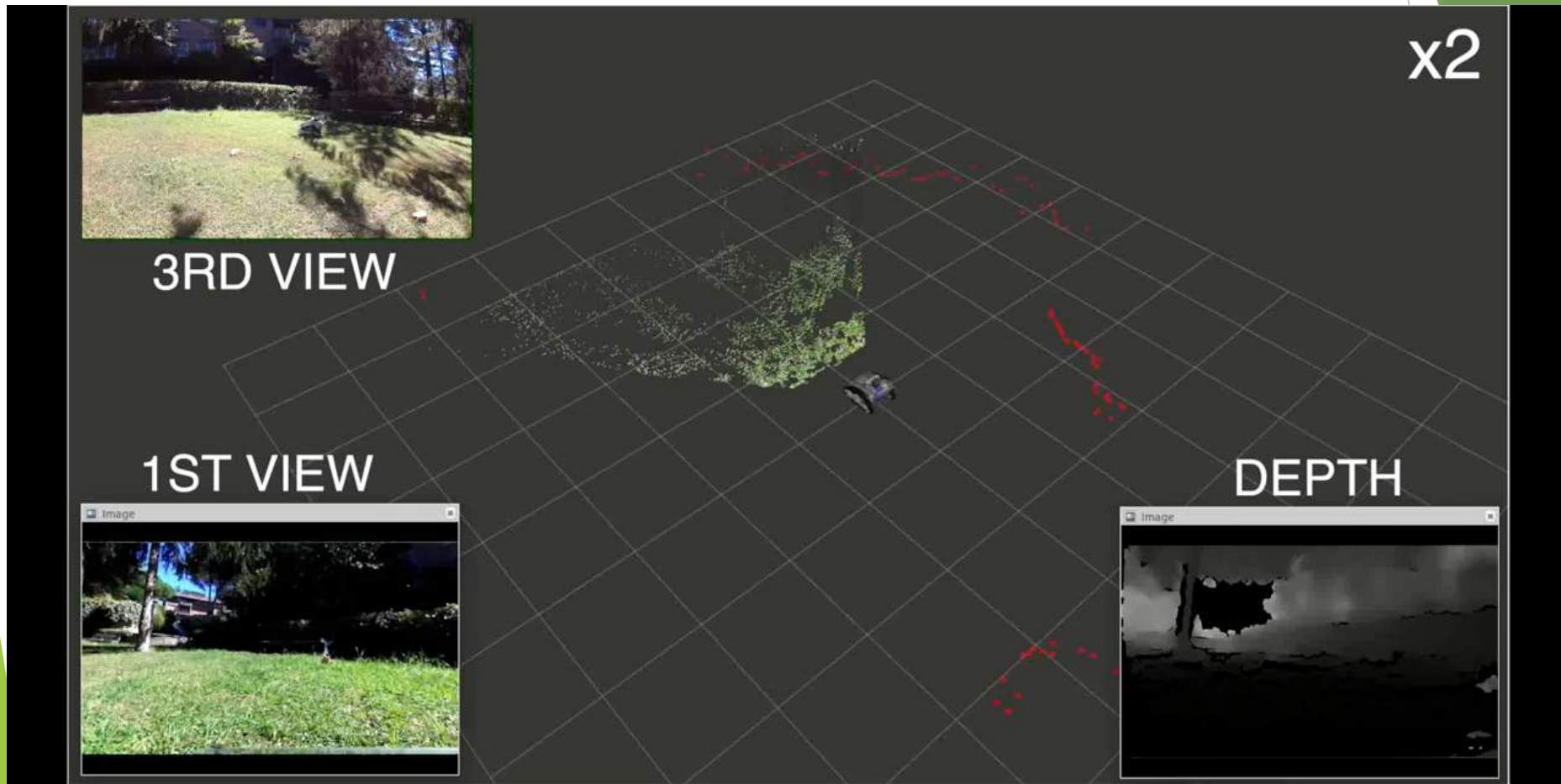
Panther and learning system



3D Reconstruction



RTABMap 3D reconstruction - Video



<https://www.youtube.com/watch?v=dfKiFW3SGEs>

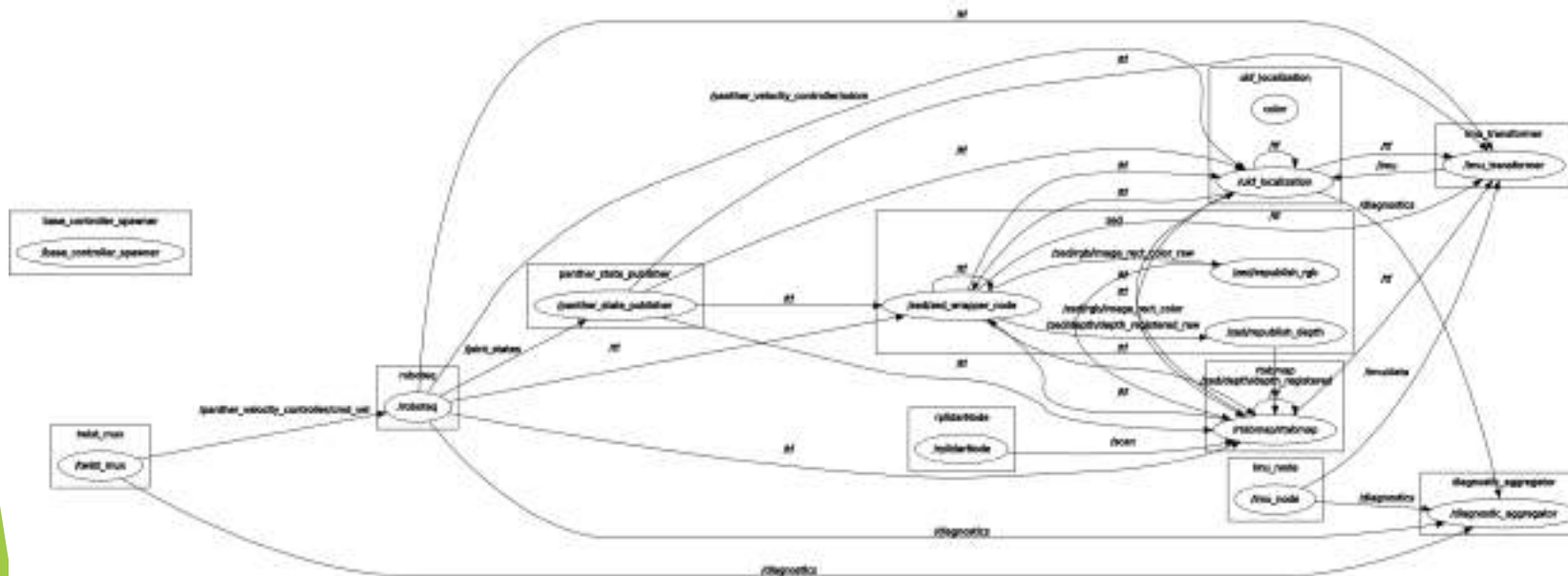
How it's works 3D reconstruction



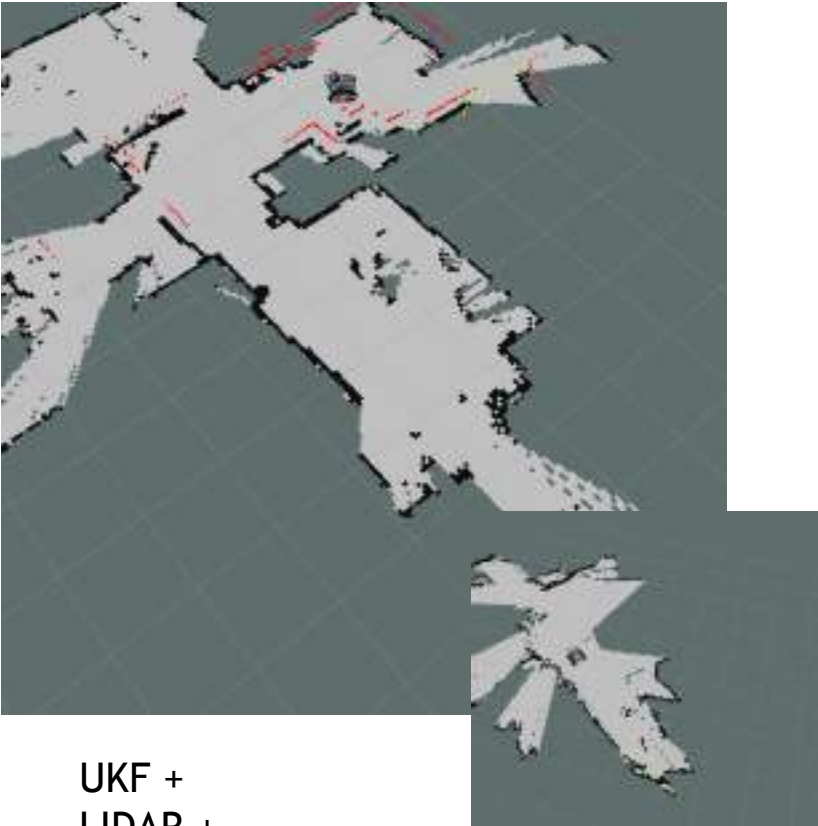
ROS.org



A lot of ROS nodes working inside the Jetson TX2!

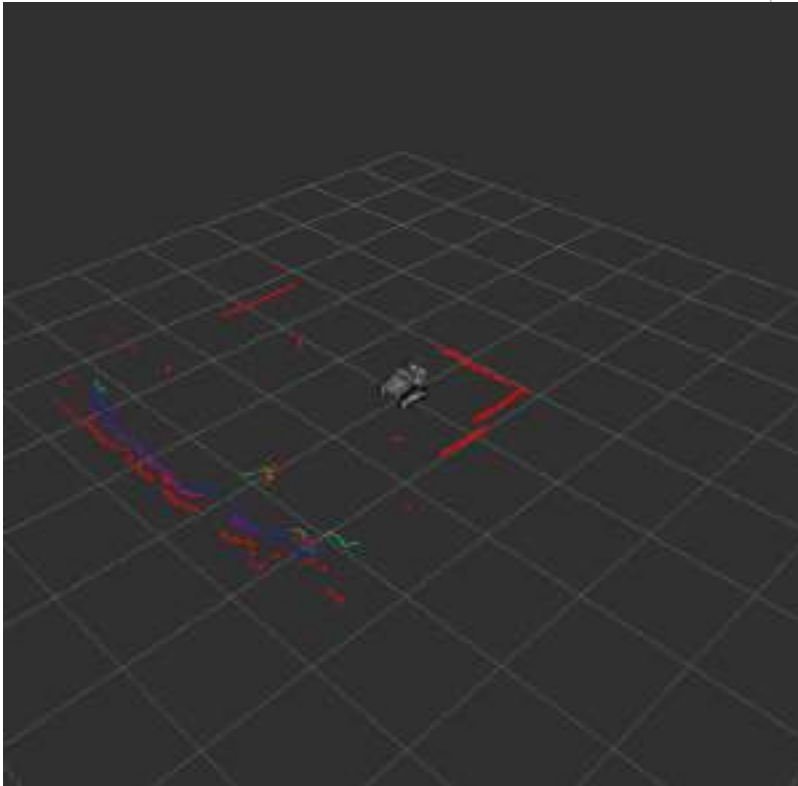


2D reconstruction



UKF +
LIDAR +
ZED

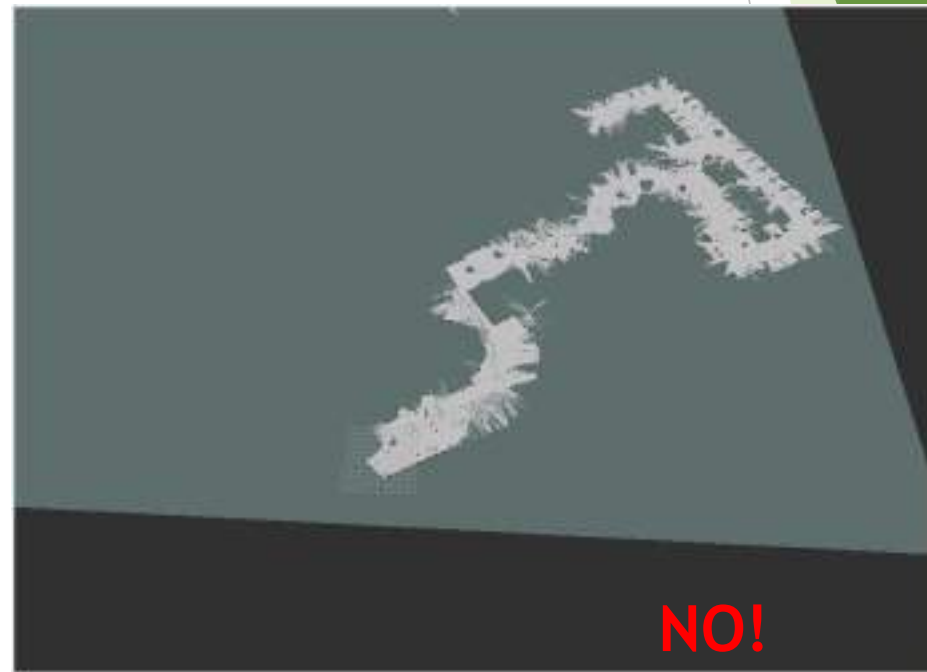
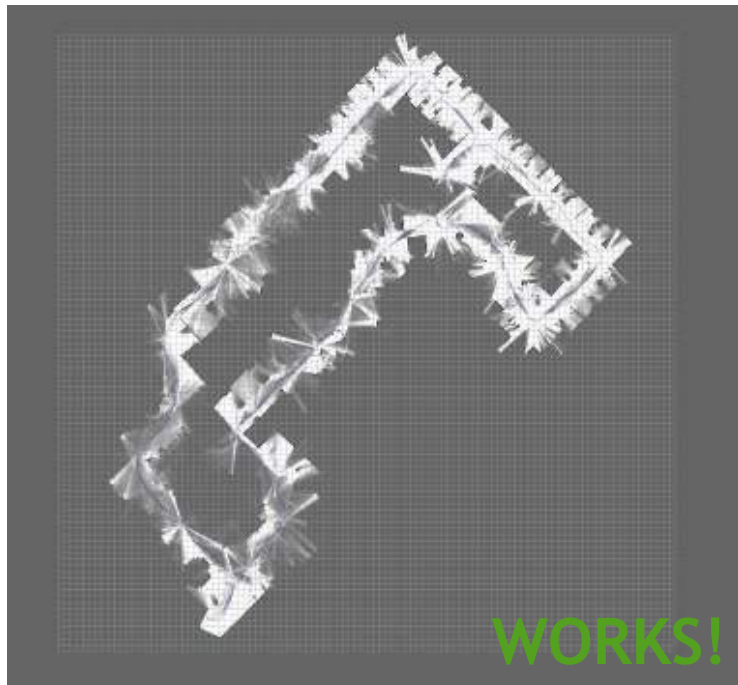
UKF +
ZED



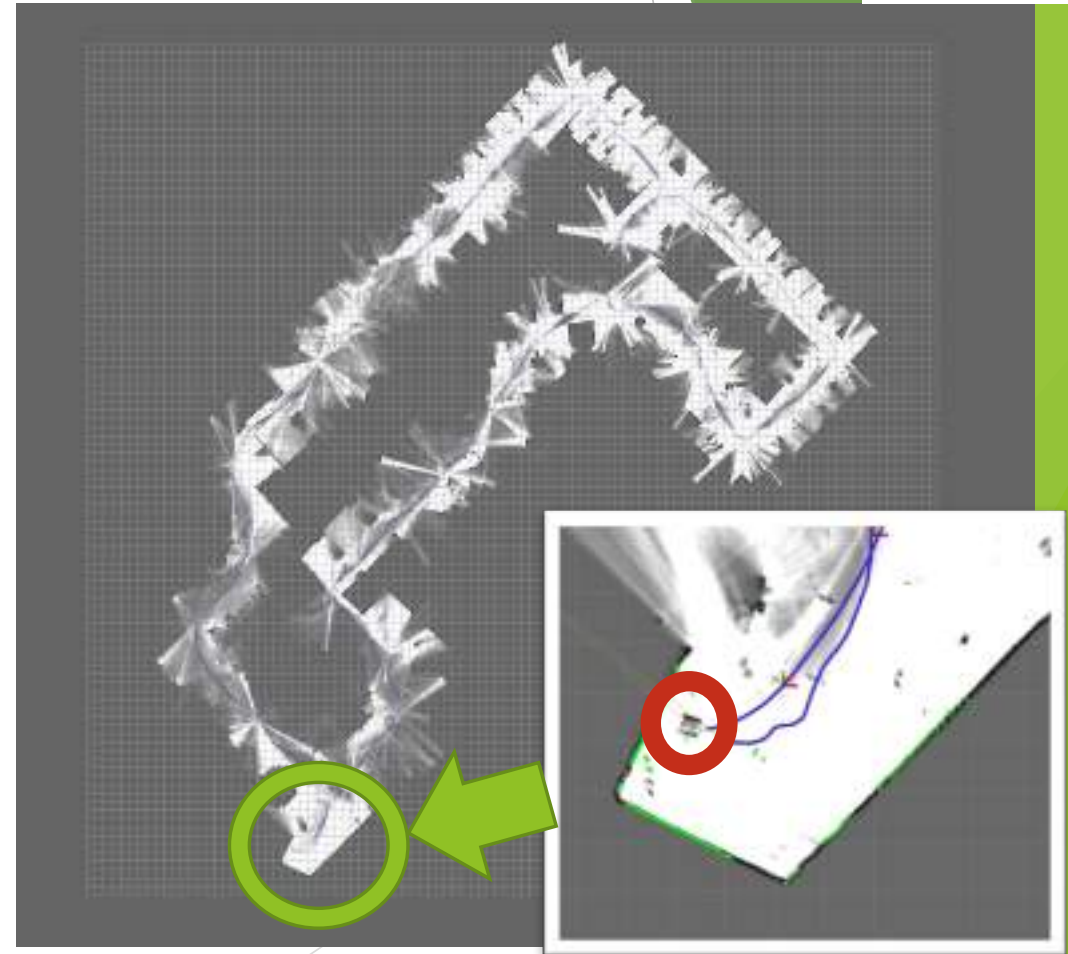
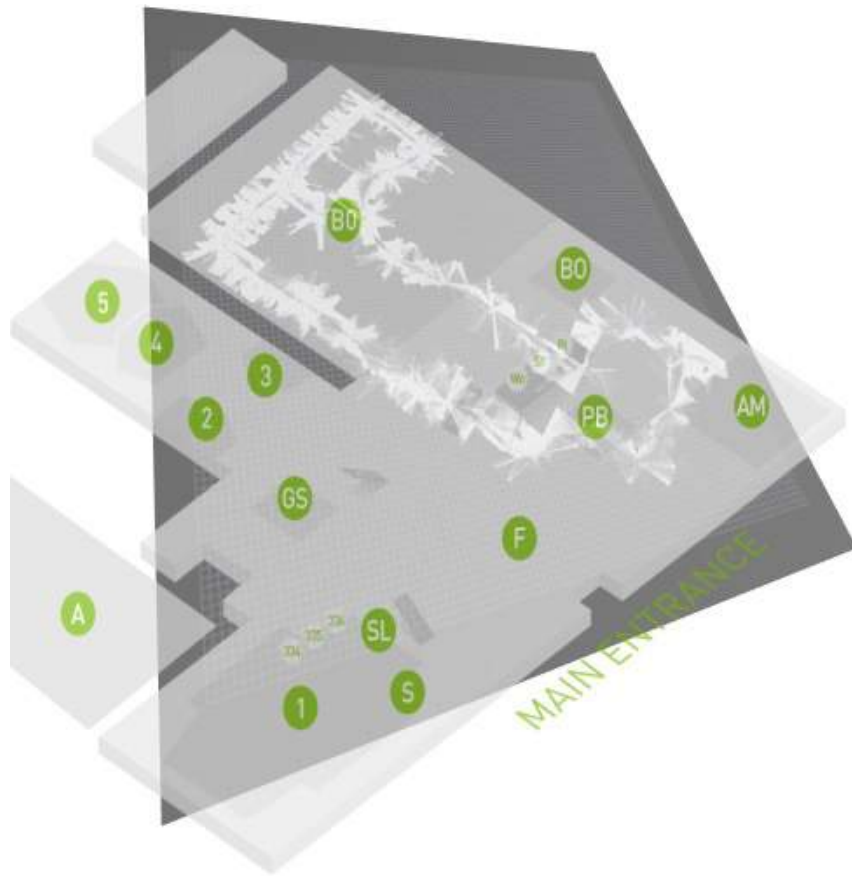
Difference between
LIDAR
Depth to laser scan converter

Cartographer VS gmapping

- ▶ During the GTC Europe I've test two SLAM mode in different combination:
 - ▶ Specification: **MAP SIZE 10000m²** ←
 - ▶ Flat plane
 - ▶ A lot of structured information ☺
 - ▶ A lot of people ☹



Cartographer



Robot Augmented reality

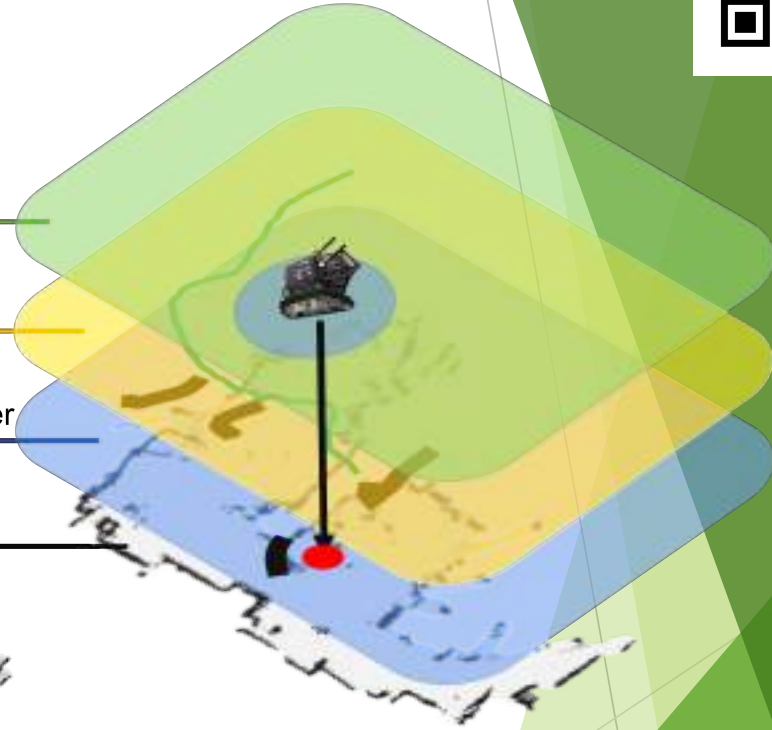


Learning layer

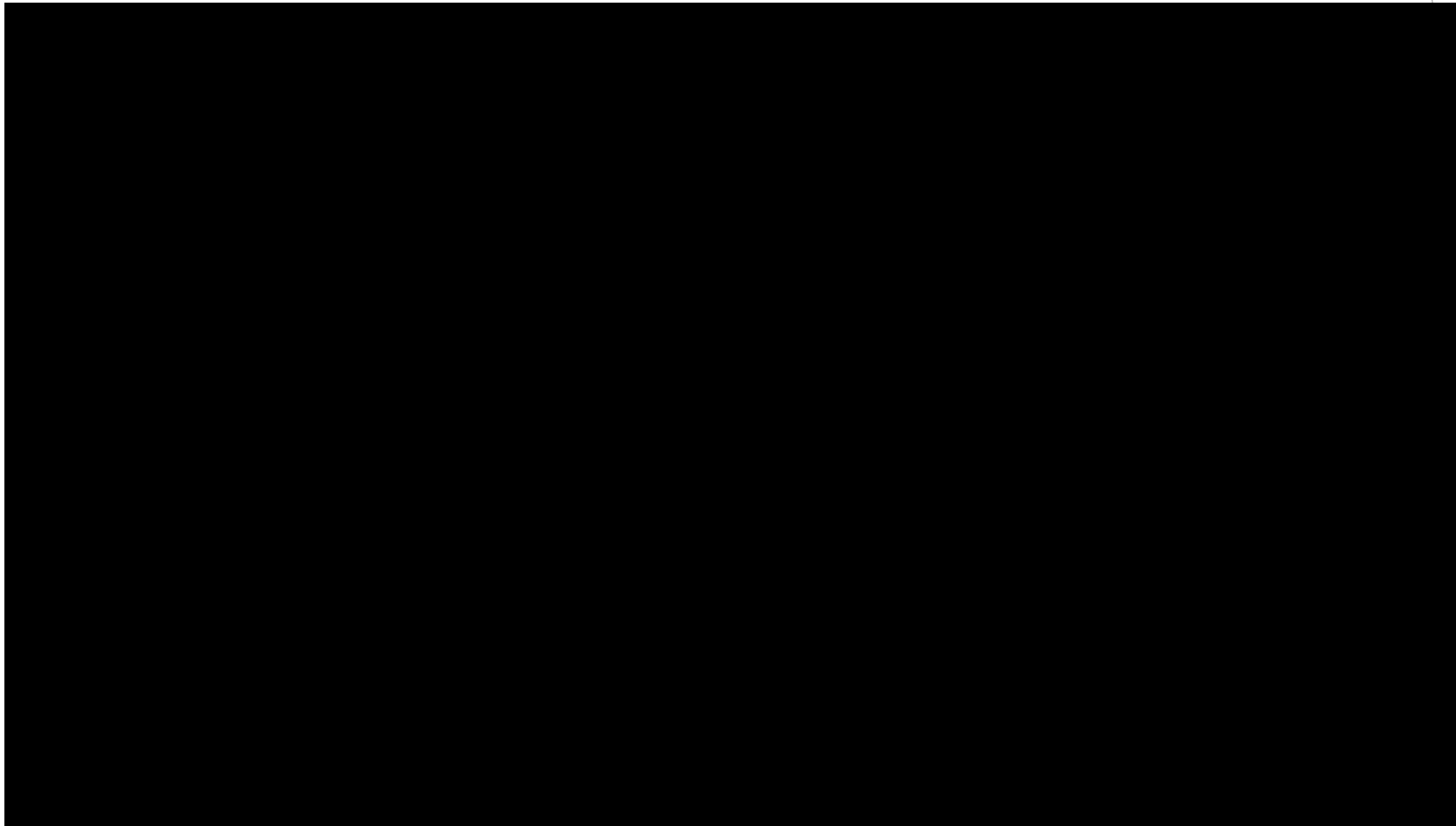
Path layer

Augmented map layer

Map layer



Augmented reality - Video



<https://www.youtube.com/watch?v=rzTBSHTWRxg>

GPU TECHNOLOGY CONFERENCE

2017/12/12~13 | 東京 | #GTCJapan
<http://www.gputechconf.jp/>



CONNECT

NVIDIAをはじめ日本中から集まる GPU の専門家と交流



LEARN

数多くの技術セッションとポスター展示、大規模なハンズオンラボで学びを深める



DISCOVER

AIや自動運転といった重要な領域でのブレークスルーに GPU が果たしている様々な役割を発見



INNOVATE

新進気鋭のスタートアップによる破壊的イノベーションに注目

GTC Japan 2017 は 2017年12月12 ~ 13日に東京で開催

日本最大の GPU 技術イベントにぜひご参加ください

#JetsonDevChallenge!

優勝者には賞金も】 NVIDIAはNVIDIA Jetson AIスーパーコンピューターを使った独創的な #AI プロジェクトを募るコンテスト、NVIDIA [#JetsonDevChallenge](#) を開催します！詳細は公式ブログにて



Grazie!

Thank you

ありがとうございました



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