



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee_{PhD}
information technology
electrical engineering



Martina Guerritore

LiDAR systems for assisted driving in the railway sector

Tutor: Prof. Mauro D'Arco

co-Tutors: Ing. Luigi Fratelli Ph.D.
Ing. Giuseppe Graber Ph.D.
(Hitachi Rail STS)

Cycle: XXXVI

Year: First

My background

- **Master Science degree: Biomedical Engineering**
- **University: Federico II University of Naples**
- **PhD start date: 1st November 2020**
- **Research group: Electrical and Electronic Measurements**
- **Scholarship type: *INPS - Dottorati INNOVATIVI – Intersettoriali, vertenti sulle tematiche dell’iniziativa “Industria 4.0”***
- **Partner company: Hitachi Rail STS**

Research field of interest: context

➤ *Assisted driving system for Tram*

The trams are receiving significant attention because they

- represent a sustainable solution for zero-emission*
- are well integrated into the existing urban context*

To support this expected spread of tramways, its safety and its integration into the urban area must be maximized.



Existing approach:

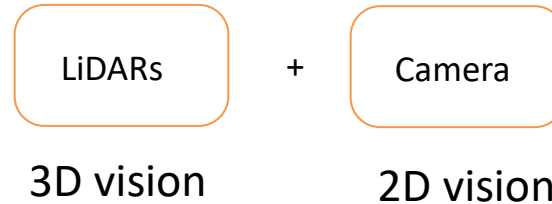
Camera

Disadvantages:

- 2D vision
- dependence on scene illumination

Research activity: Proposed approach

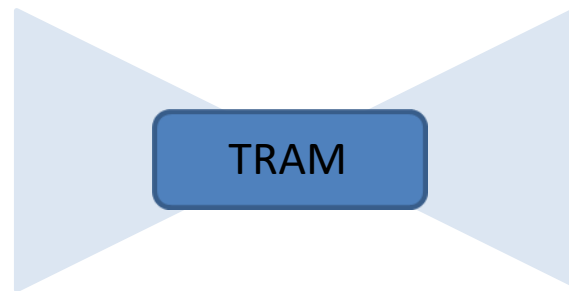
We propose an assisted driving system based on the fusion of:



that provides:

- Recognition of moving objects in 3D
- Tracking of moving objects
- Alerts the driver about possible dangers/obstacles

■ *field of view of sensors*



The sensors were mounted onboard the tram and system is validated on urban lines in Naples.

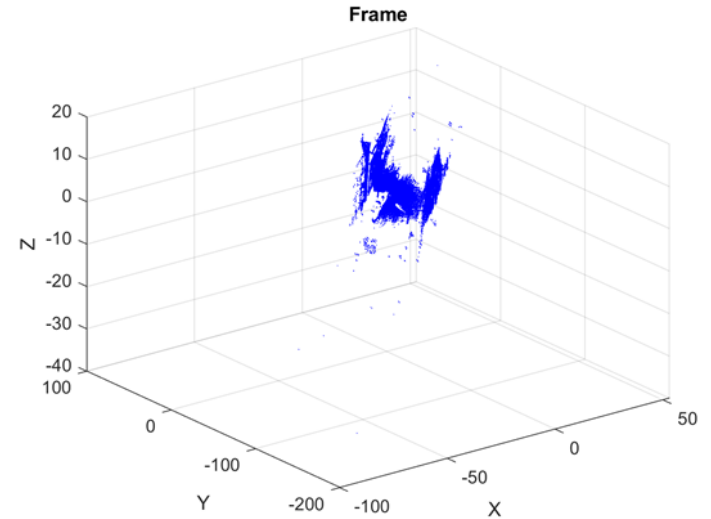
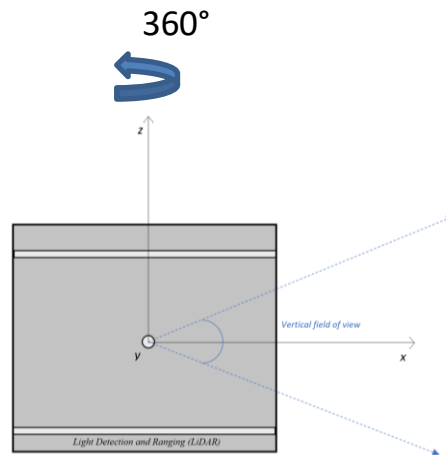
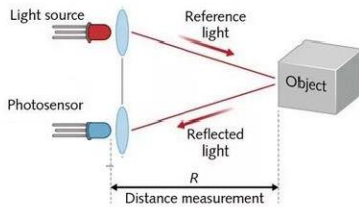
The focus of my Ph.D. program is
LiDAR Object Detection



Research activity: Proposed approach

A brief introduction on LiDAR system:

Light Detection and Ranging (LiDAR) is a technology, based on the transmission and reception of an impulse and giving back a points cloud with distance measurements of objects in the surrounding environment.



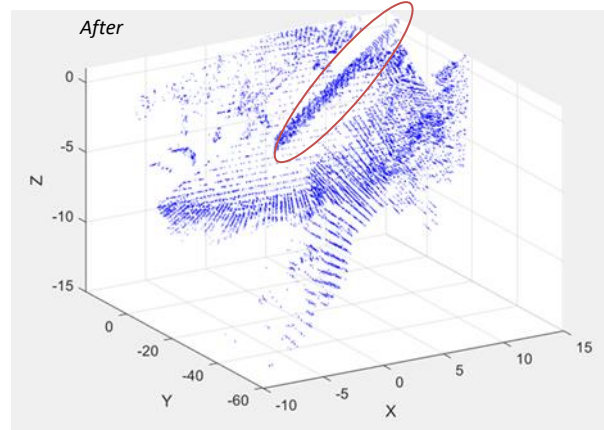
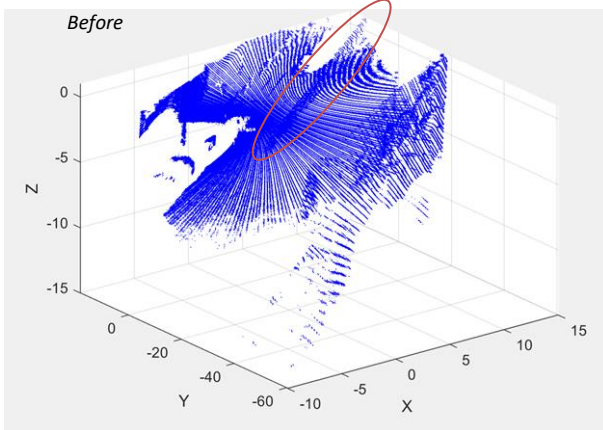
Research activity: Proposed approach

LiDAR Object Detection includes the following steps:

- Region of Interest (ROI)
- Background filtering
- Clustering
- Classification of moving objects
- Tracking of moving objects

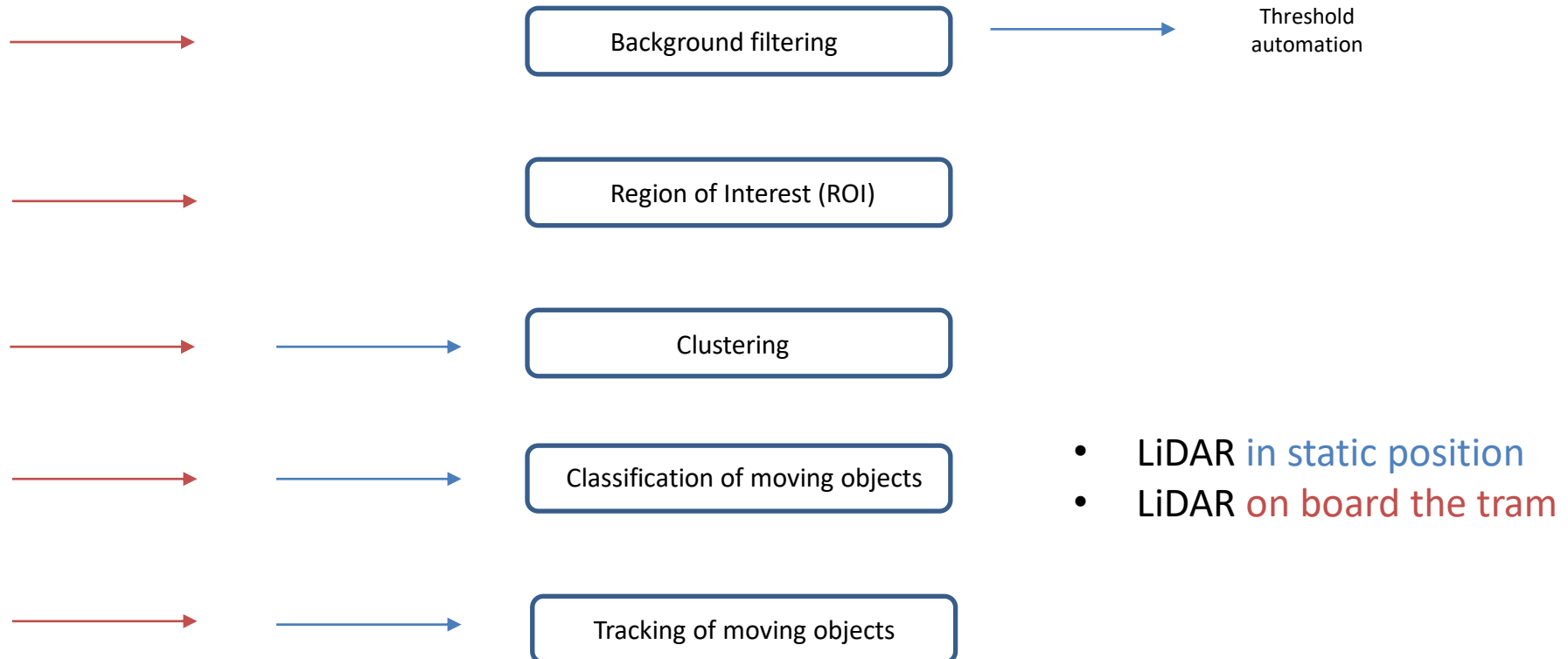
Background filtering:

Motorcycle



- LiDAR in static position
- Worst case without ROI application

Research activity: Future tasks



Products

- *Smart living technologies for gait analysis in ergonomics, sport, rehabilitation and clinical diagnostics*, Mauro D'Arco, Martina Guerritore and Annarita Tedesco. Accepted and withdrawn to IEEE conference. Submitted to MDPI.
- *Multi-sensor data fusion approach for kinematic quantities*, Mauro D'Arco and Martina Guerritore. It will be submitted to MDPI in the next few days.

Summary of study activities

- *My study focuses on deepening the LiDAR system, its functions, and the reference literature.*

- Ad hoc ITEE PhD courses :

Statistical data analysis for science and engineering research.

Scientific Programming and Visualization with Python

Matrix Analysis for Signal Processing with MATLAB

- Courses borrowed from MSc curricula:

Tecniche ed elaborazione dei segnali per la bioingegneria , Proff. Antonio De Maio and Vincenzo Carotenuto (3CFU)

Machine Learning e Big Data per la salute, Prof. Vincenzo Moscato

- Conferences / events attended

Doctoral School : PhD Excellence School "I. Gorini" 2021

Thanks for your attention