# TRIMBOT 2020

## Robotereinsatz zum automatischen Stutzen von Buchsbaum und Rosen

## KTBL-TAGUNG

Robotics und Automatisierung im Gartenbau
17. und 18. September 2018 in Erfurt

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# TrimBot 2020
## Stutzen von Rosen, Buchsbaum und Hecken

**Was braucht ein Roboter um dies durchführen zu können?**


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# TrimBot 2020


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## Herausforderungen

- Selbständiges Navigieren durch einen Garten
- Zurückschneiden von Buchsbäumen und Hecken auf eine vordefinierte Form (z.B. Kugel)
- Zurückschneiden von Rosen

- Kamerabasierte Umgebungs- und Objekterkennung
- Integration auf einem kleinen Roboter mit begrenzten Ressourcen



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# TrimBot 2020
# Garden Trimming Robot

Research the robotics and vision technologies to prototype the first outdoor garden trimming robot

**Rijksuniversiteit Groningen (NL)**
Intensity image analysis, algorithmic performance
(Speed up algorithms for object detection)

**The University of Edinburgh (UK)**
Co-ordination and range image analysis
(To perceive objects in the garden from camera data)

**Albert-Ludwigs-Universität, Freiburg (DE)**
Motion stereo, depth image analysis
(Obtain 3D data from a moving stereo camera on the mobile platform)

**Eidgenössische Technische Hochschule Zürich (CH)**
3D SLAM, depth image analysis
(Reconstructing the map of the garden from the moving robot platform)

**Wageningen University and Research Centre (NL)**
**(Farm Technology Group and DLO Greenhouse Horticulture)**
Mechatronics, motion planning, active perception and plant modelling
(Construction and control of the robot arm, design of cutting tools and predict plant growth)

**Universiteit van Amsterdam (NL)**
3D Data analysis and scene understanding
(Recognize the objects in the garden and label them)

**Robert Bosch GmbH (DE)**
Mobile platform, planning and navigation
(Construction of the robot base, ensure that it is able to move over different types of terrain)


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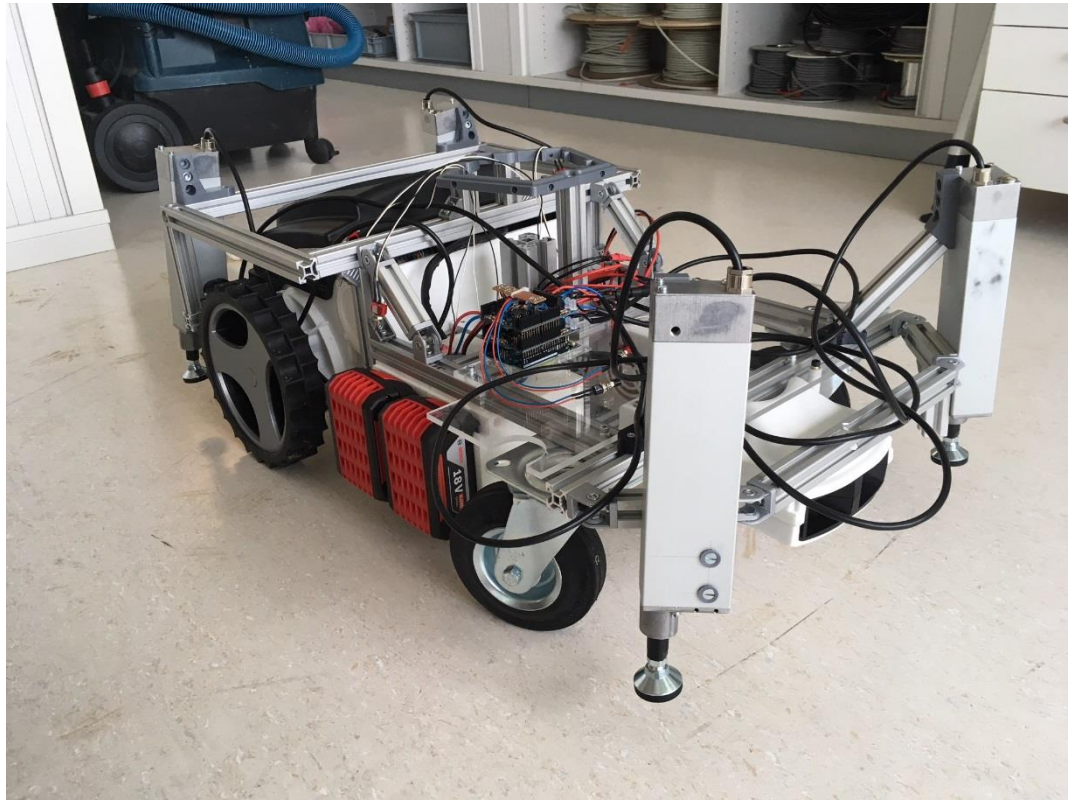
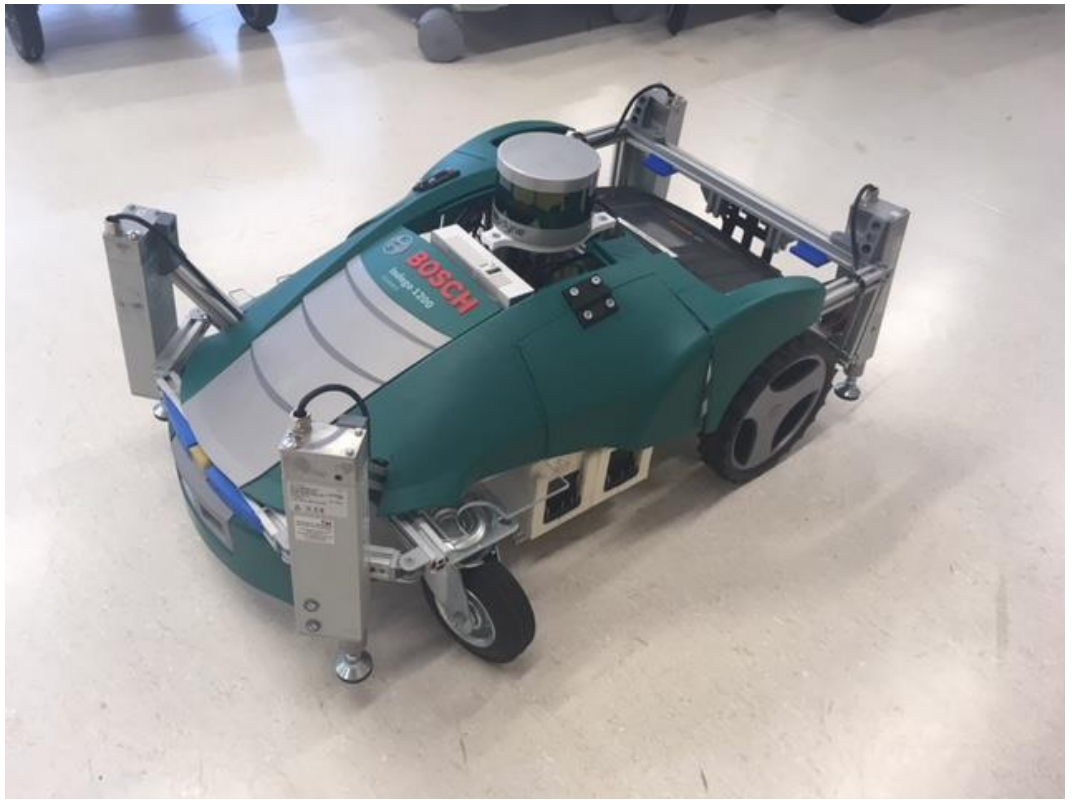
## Prototype







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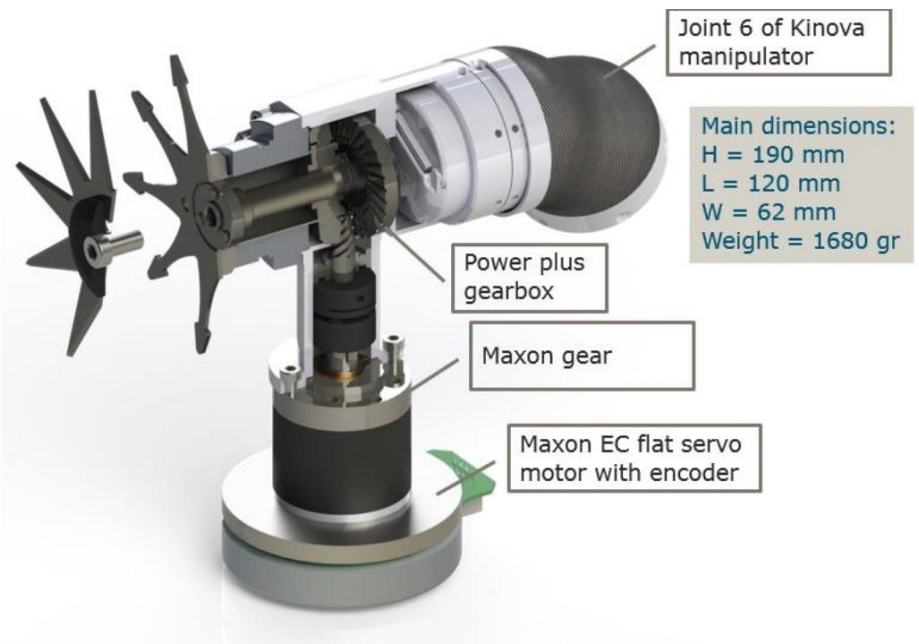
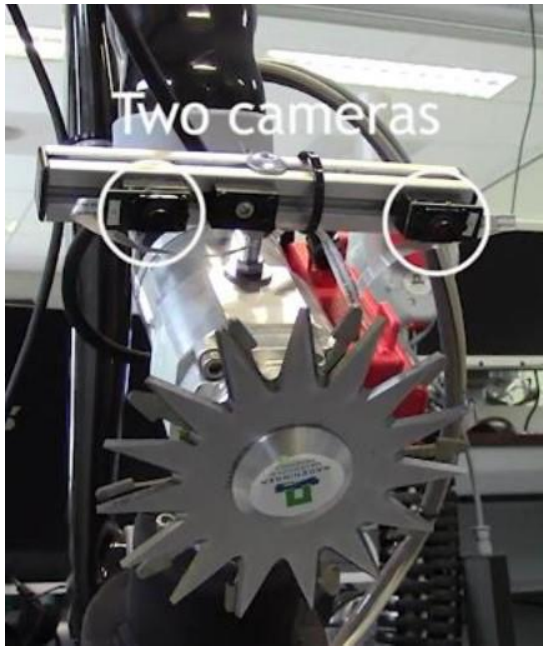
## Bush Trimming Tool



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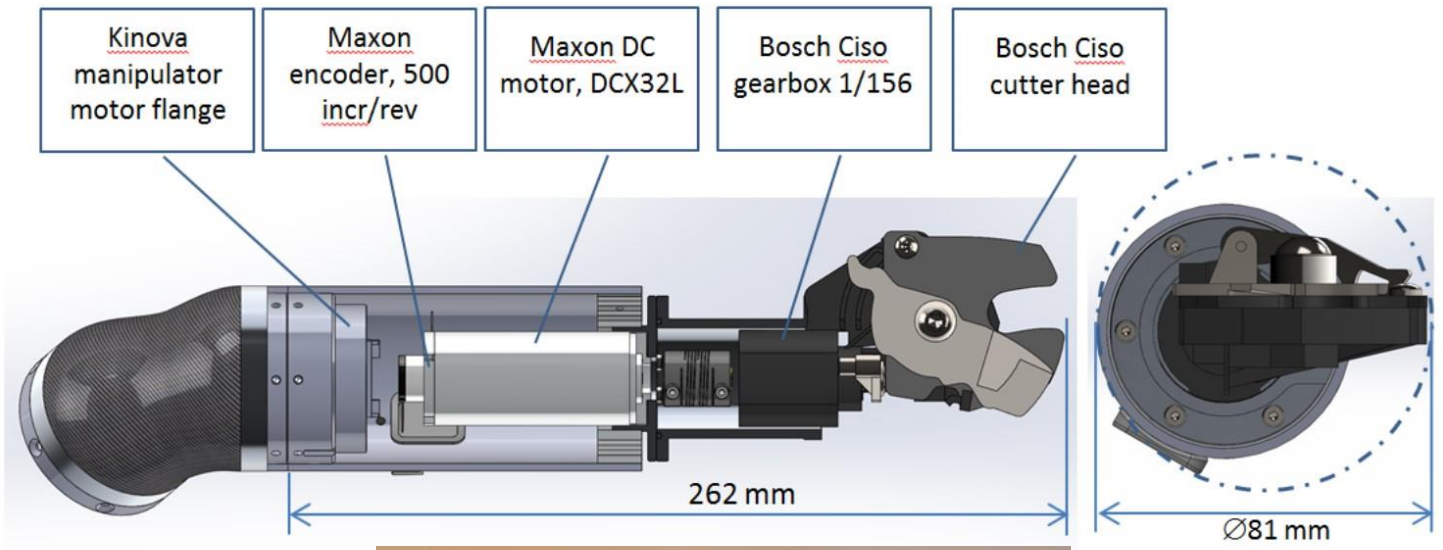
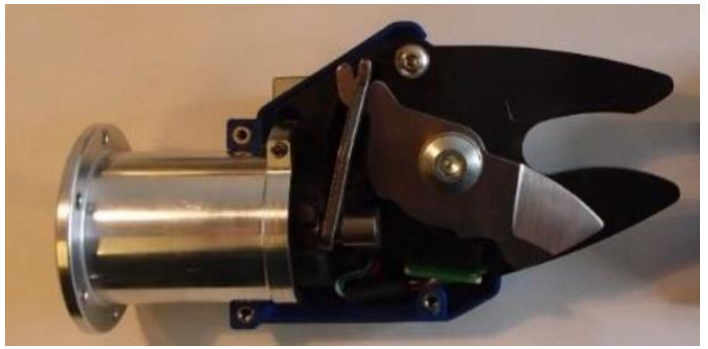
## Rose Clipping Tool





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## First Bush Trimming



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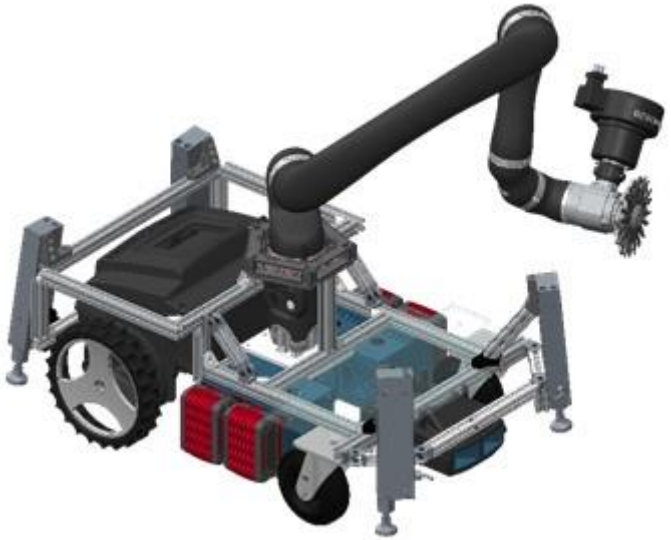



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## Vehicle Arm Integration


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## Testgarden in Wageningen


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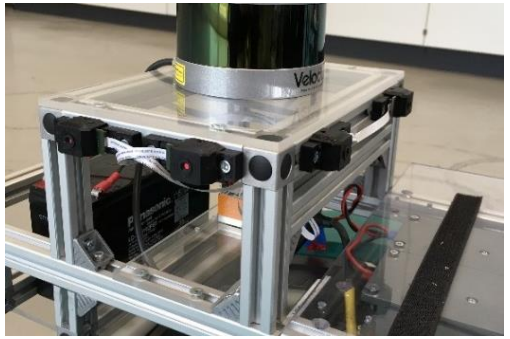
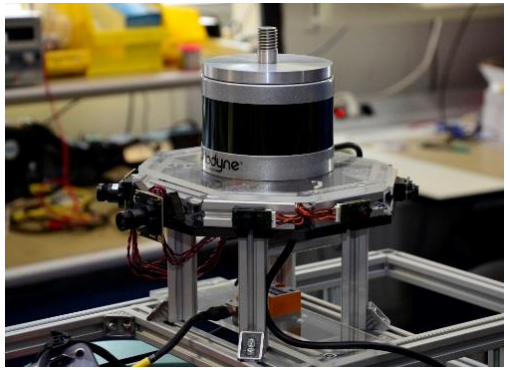
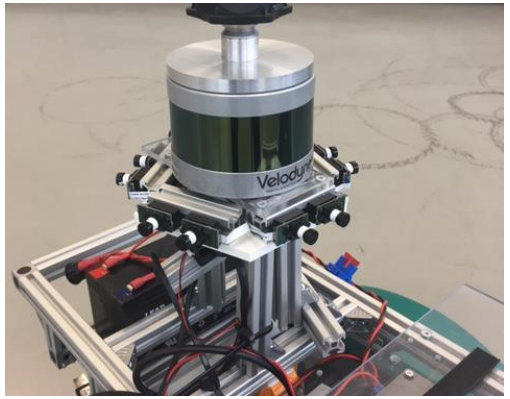
# TrimBot 2020
## Sensor Setup



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# TrimBot 2020
## Visual SLAM (ETHZ)


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## Leica Reference Pointcloud Testgarden Wageningen


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# TrimBot 2020
## Leica Reference Pointcloud Testgarden Renningen


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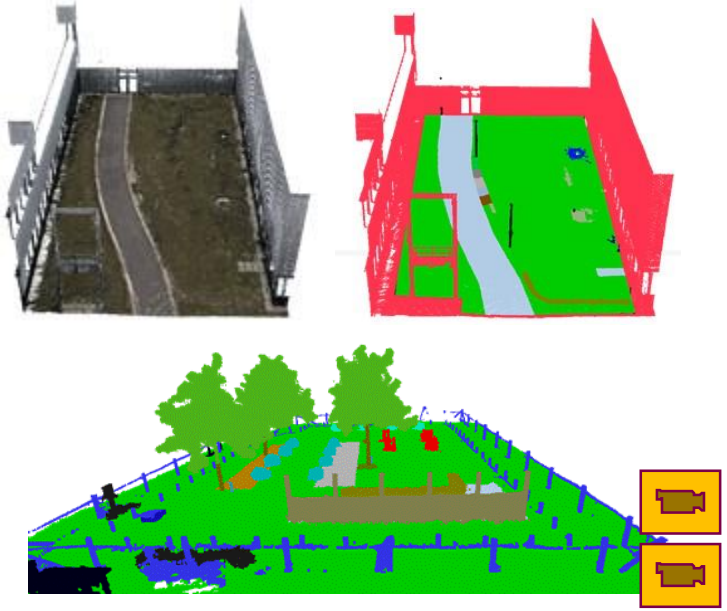
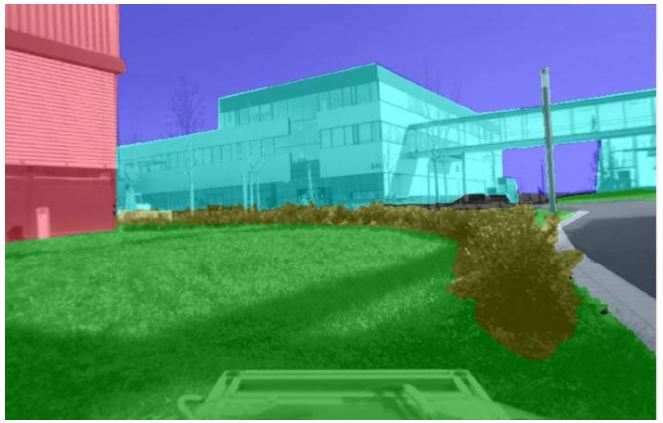
## Semantic Scene Interpretation



- Sematic annotated pointlcouds for Trimbot testgardens
  - Projection from semantic pointclouds into camera images
  - ICCV 2017 Workshop: 3D Reconstruction meets Semantics
    - Including a semantic reconstruction challenge
    - Bosch contributed in data collection and preparation for the challenge data sets
    - http://trimbot2020.webhosting.rug.nl/events/3drms/





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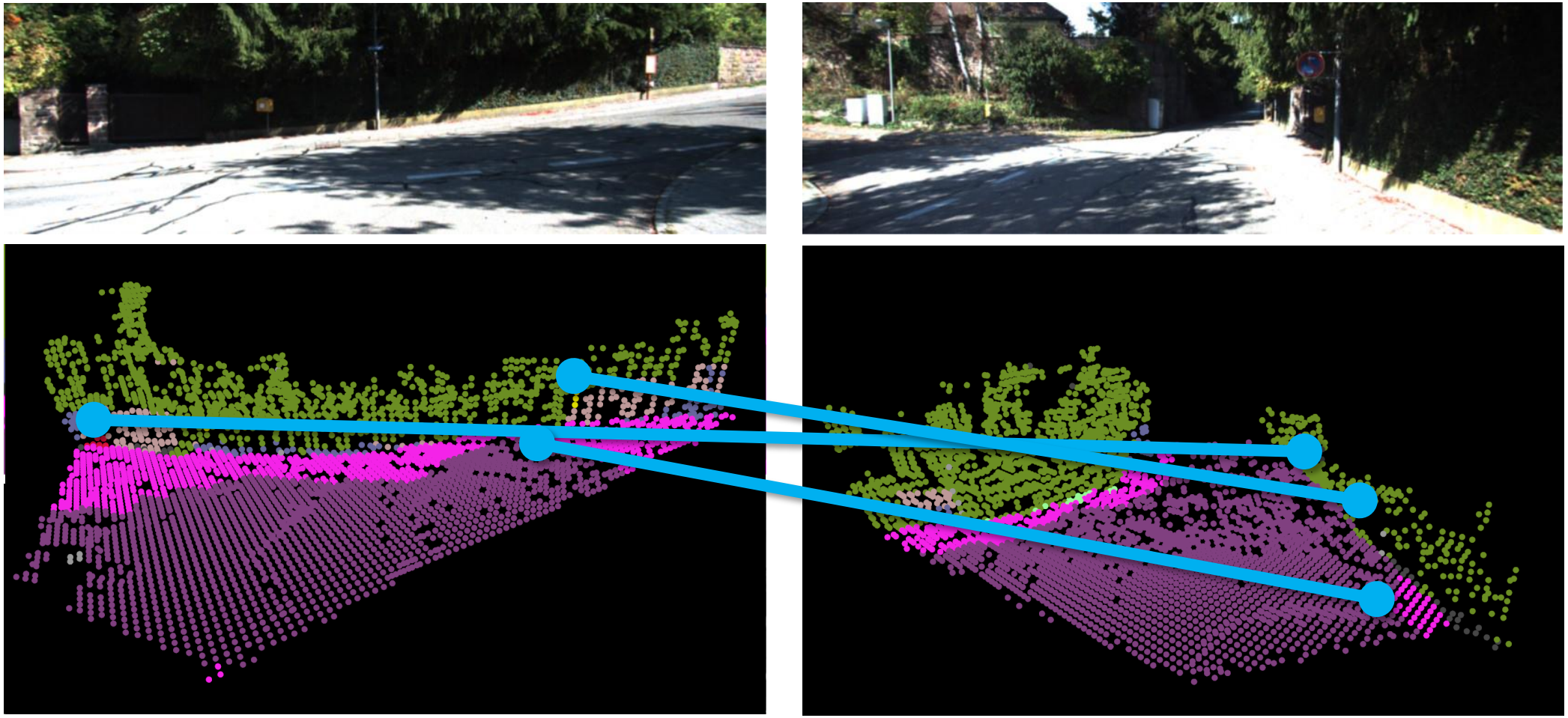
## Semantic SLAM

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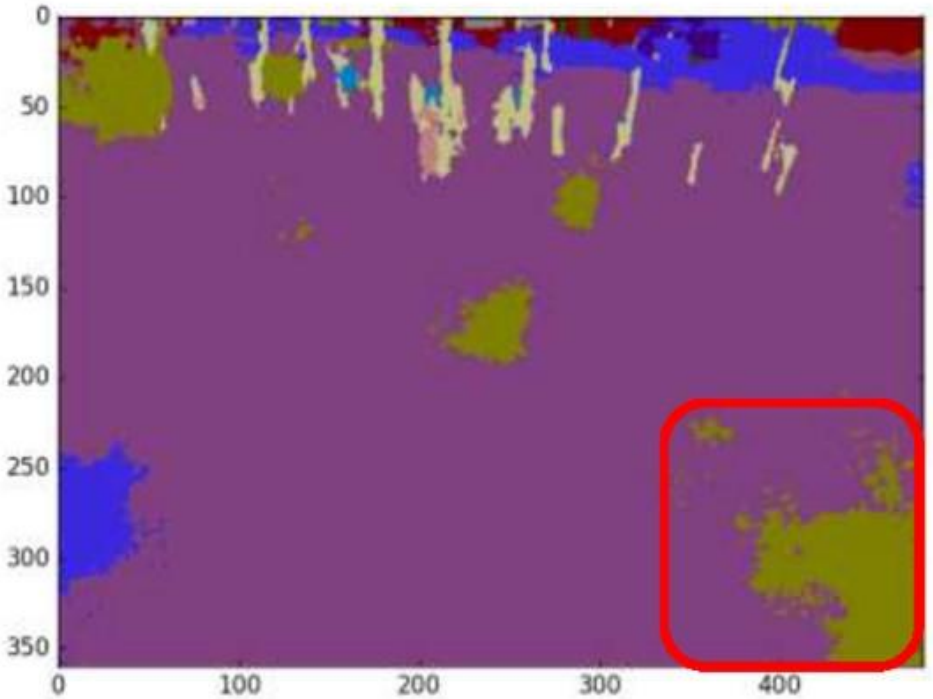
# TrimBot 2020
## Recovering Albedo and Illumination (Amsterdam)

- Segmentation, recognition, and motion estimation are confounded by illumination effects



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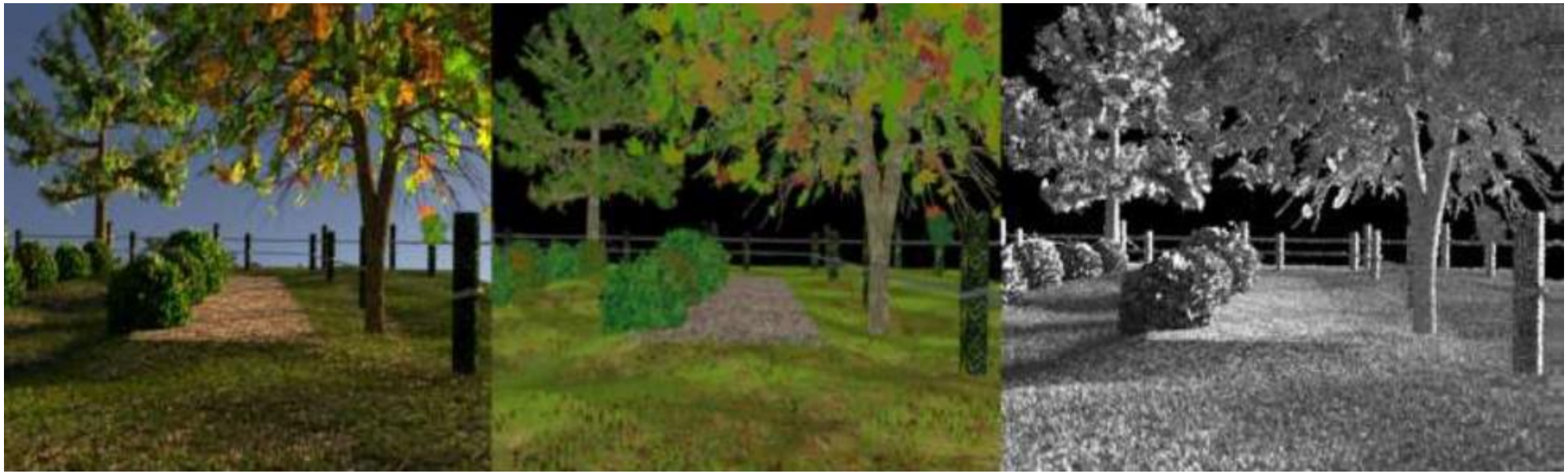
# TrimBot 2020
## Recovering Albedo and Illumination (Amsterdam)

- Factorizing an image into component images that separate the intrinsic material properties of depicted objects from illumination effects
  - Reflectance
  - Shading

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## Synthetic Garden Dataset (Amsterdam)


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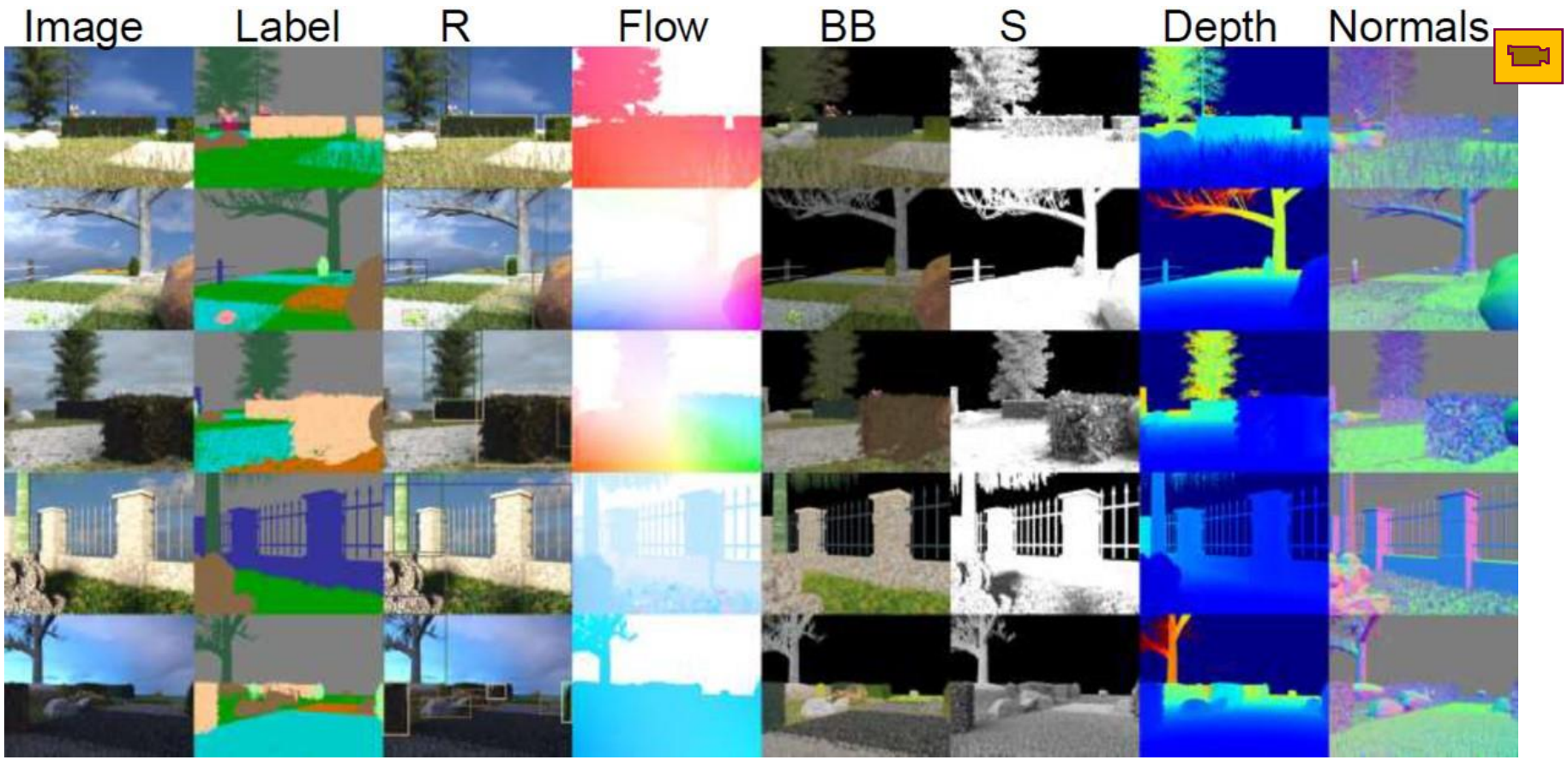
# TrimBot 2020
## Synthetic Garden Dataset (Amsterdam)





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- YouTube
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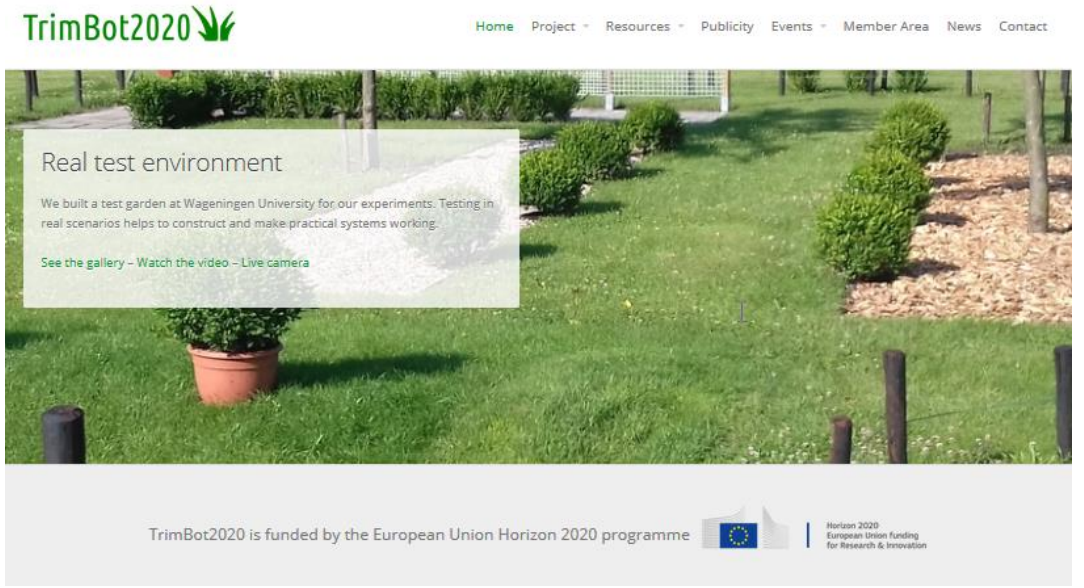


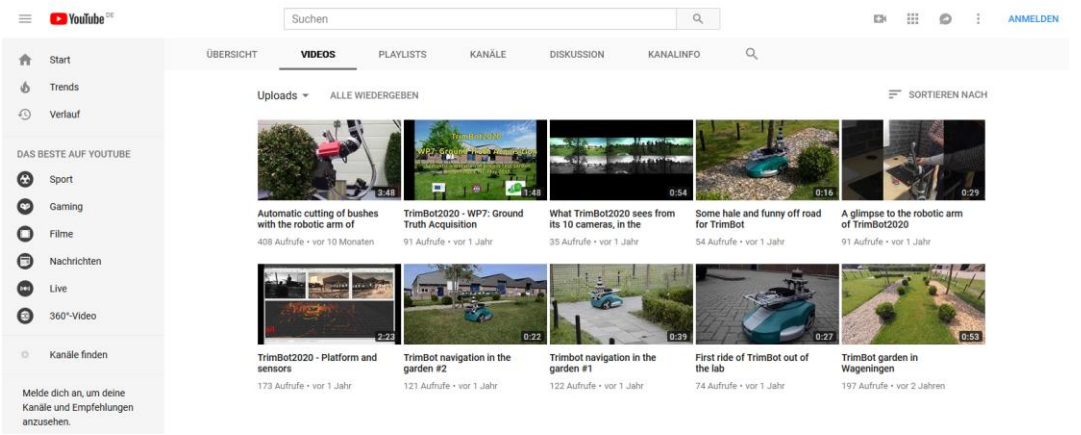


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