Project brief

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Project

- Goal:
  - Project proposal for a new use of sustainability robotics
  - 5 minute presentation / video

- Project proposal
  - Introduction
    - Concept and objectives
  - State-of-the-Art
  - Implementation
    - Methodology
  - Impact
    - Timeline and future plans
    - Budget
  - Technical demo / pilot result

Individual Project

- Topic: Anything related to sustainability robotics
  - E.g., Monitoring, precision agriculture, fruit picking, weeding
  - Run it past us!

- Will have constraints on choice of robot, sensor, manipulator, and video / dataset

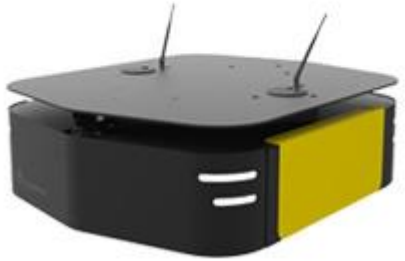
Constraints

- You can freely choose between components from the *Clearpath Robotics* e-shop

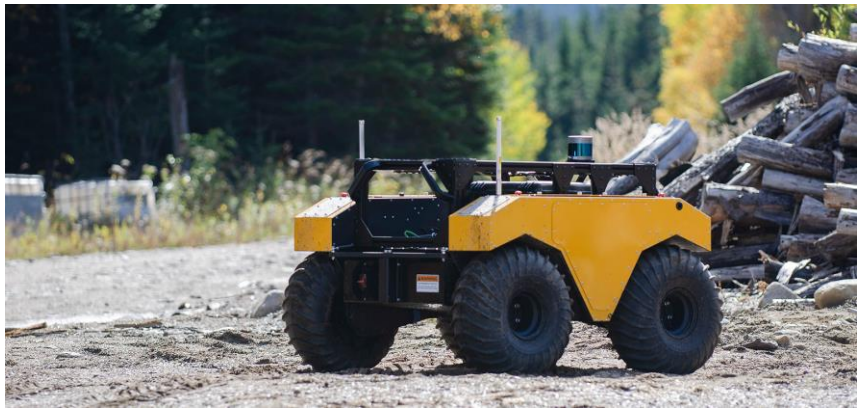
- Justify your choice in robot / sensor / manipulator
  - Some components will be “better” than others, but could be excessive
    - E.g., Price vs functionality
    - E.g., Weight

Constraints – Robot

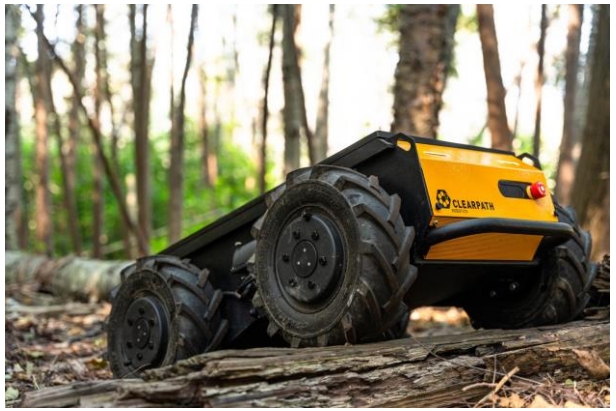
- Choice of robot – Clearpath robotics
  - Husky, warthog, jackal, ridgeback



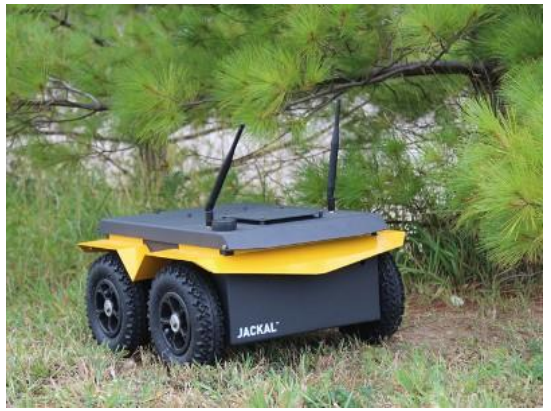
Ridgeback



Warthog



Husky



Jackal

Constraints – Sensor choice

- 2D LIDAR
  - Hokuyo UTM-30LX-EW, Hokuyo URG-04LX
- 3D LIDAR
  - Blickfeld Cube 1 Outdoor, Velodyne Puck, Velodyne Ultra Puck
- Camera
  - FLIR Ladybug6, Intel RealSense D455 (and D455f), Stereolabs ZED 2i, FLIR A400/A700 Smart Sensor, FLIR Blackfly S
- IMU
  - Xsens MTi-610, Lord Sensing 3DM-CX5-10

Constraints – Manipulator

- Arm
  - Kuka iiwa 14 R280, Universal Robotics UR(3, 5, 10)
- Gripper
  - qbrobotics Softhand2 Research, qbrobotics Softhand Industry, qbrobtics softclaw

- You can mount other tools onto the arm, so long as its reasonable and feasible. You must justify why.
  - Choosing not to use a manipulator is also an option

Non-Clearpath choices

- Laser rangefinder: Garmin LLV3HP
- Thermal image: Terabee Evo Thermal 90
- Hyperspectral camera: HySpex Mjolnir S-620, HySpex Mjolnir VS-620
- Multi-spectral camera: Mapir Survey 3N (choice of filter)

Constraints summary

- Robot:
  - Clearpath robotics: Husky, warthog, jackal, ridgeback
- Sensors
  - 2D LIDAR: Hokuyo UTM-30LX-EW, Hokuyo URG-04LX
  - 3D LIDAR: Blickfeld Cube 1 Outdoor, Velodyne Puck, Velodyne Ultra Puck
  - Camera: FLIR Ladybug6, Intel RealSense D455 (and D455f), Stereolabs ZED 2i, FLIR A400/A700 Smart Sensor, FLIR Blackfly S
  - IMU: Xsens MTi-610, Lord Sensing 3DM-CX5-10
- Arm
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- Non-Clearpath:
  - Laser rangefinder: Garmin LLV3HP
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Demo

- In the proposal, we need evidence that your team is technically good to proceed

- Must do *something* technical that relates to your chosen topic
  - E.g., Localise a robot in a field, detection of fruits / vegetables, detection of crop rows
  - Should relate to your given topic!

- Will be given a choice of datasets
  - You need to show the results within the presentation

Demo – Dataset 1: Rosario

- Robot navigating a field
- Available data:
  - Image sequences (video)
  - Encoders, IMU
  - GPS-RTK as a baseline
- Options:
  - Crop row detection
  - Robot localisation
- *There are five different "sequences" (videos)*
  - *Only use sequence 1 or 2*

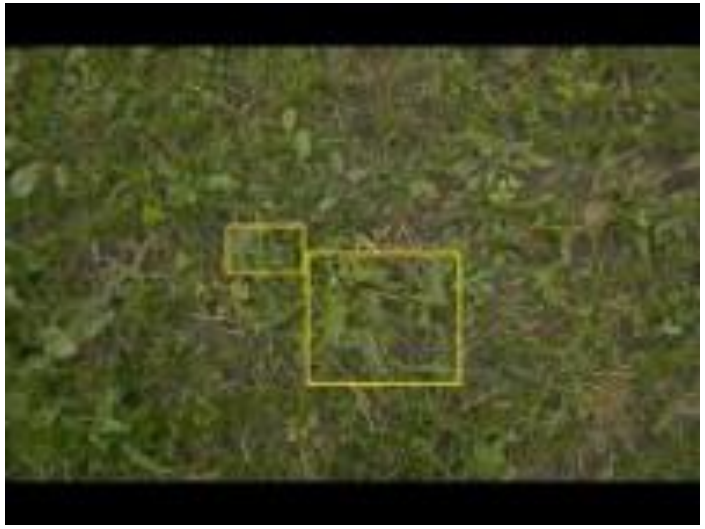
https://journals.sagepub.com/doi/10.1177/0278364919841437, https://robot.cifasis-conicet.gov.ar/index.php/P%C3%A1gina_principal

Demo – Dataset 2: RumexWeeds

- Weeds in grasslands
- Data includes:
  - Video with bounding boxes for weeds
  - 100 images with labelled and segmented weed masks
- Options:
  - Weed detection
  - Weed segmentation

(a) Ground truth masks

(b) Rumex Crop Predictions



https://dtu-pas.github.io/RumexWeeds/

Demo – Dataset 3: ACFR Orchard Fruit Dataset

- Fruit on vines
  - Apples, mangoes, almonds
  - 1120, 1964, 620 images total
- Data
  - Images not in sequence
    - Not a video
- Options
  - Fruit detection
  - Fruit classification

http://data.acfr.usyd.edu.au/ag/treecrops/2016-multifruit/

Project: Upcoming Timeline

- Individual project
- Projects chosen before/during class on March 4th
  - Develop 2-3 project options
- March 12th
  - Tutorial on Image Manipulation in MATLAB and Rosario dataset
- Weekly project work during tutorial
  - TA will meet with every group to discuss progress / technical challenges
- Guest tutorial presentations:
  - Take advantage of the knowledge
- Final presentation videos on May 26th
  - Submission on Moodle the day before