ML for Robotics

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Final Project

Searching for Treasures

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Presentation of the project

1/3 Control the arm tip

We need to control the tool to stay above the interface between the flat gray squares and the greenybrown earth.

2/3 Detect mines

Any mine are installed at the interface. A **high peak of the metal detector** corresponds to a mine. In this case, we publish a cylinder marker.

3/3 Control the truck

We want to implement a controller for the truck that will keep a target distance to the floor/dirt interface while driving around the area.

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Approach

Twist command

The arm tip can be controlled with a twist command.

- linear.x : the longitudinal velocity of the arm
- linear.y : the lateral velocity (away from the truck)
- linear.z : the vertical velocity

Bang-bang control

Deep learning based on a bang-bang control method:

- On dirt: the arm retracts
- On floor: the arm extends

Thus, **position is maintained at the floor/dirt interface**.

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Encountered problems and solutions

Height decreases over time

- The tool touches the ground after a certain time of simulation.

Solution: Implement a **controller in z**.

Oscillations

- Oscillations in x due to bang-bang control.
- Oscillations in z due to the z-controller.

Solution: **Two low-pass filters (in x and in z) implemented.**

Collision arm/truck

- If too much retracted, the arm collides with the truck

Solution: **Set a boundary position at x (a frame transformation is needed)**

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Approach

Metal detector

If detector value = 1, we publish a cylinder.

Base transformation

To publish cylinders, we need to have the **truck's coordinates in the world frame** (transformation /VSV/Tool to /World).

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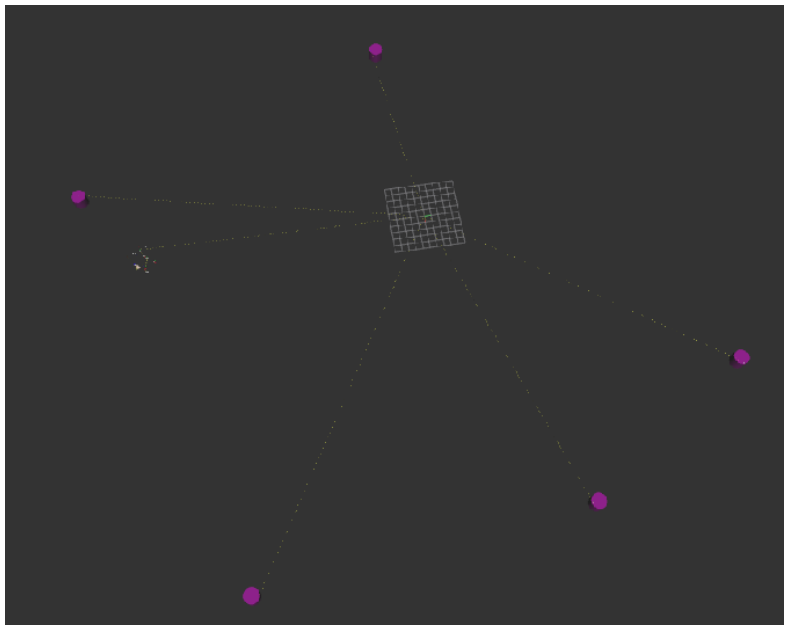
Encountered problem and solution

Several published cylinders for the same mine.

Solution : cylinders merge

If the distance between two cylinders is $<$ **cylinders diameter**, we merge the two.



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Approach

Change cameras position

Camera **advanced** on the front of the truck and **lowered**, compared to the initial setup.

Deep learning

50 % of extreme cases:

- Turn right when 'floor'
- Go back and turn left when 'dirt'

50 % of 'normal' learning.

- Follow the interface.

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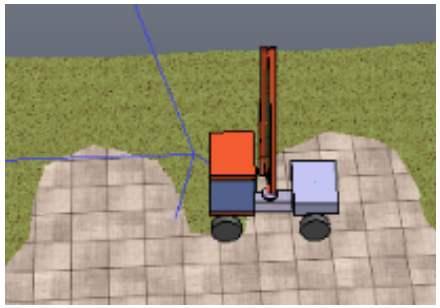
Encountered problem and solution

Truck blocked in the 'holes'

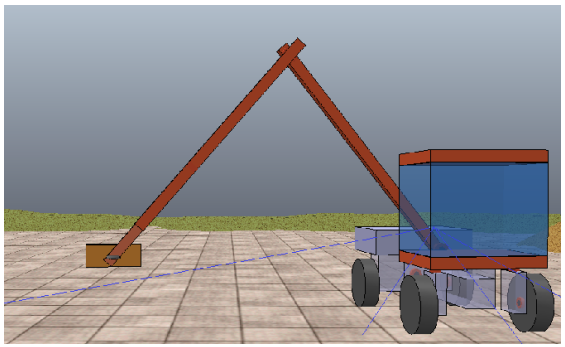


New deep learning

- Do not go into the holes

But the arm cannot reach the mines...

- Expand the arm !



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