FIRST ROBOTICS PROJECT

ROBOTICS

POLITECNICO
MILANO 1863

THE ROBOT

SCOUT 2.0

AgileX Robotics

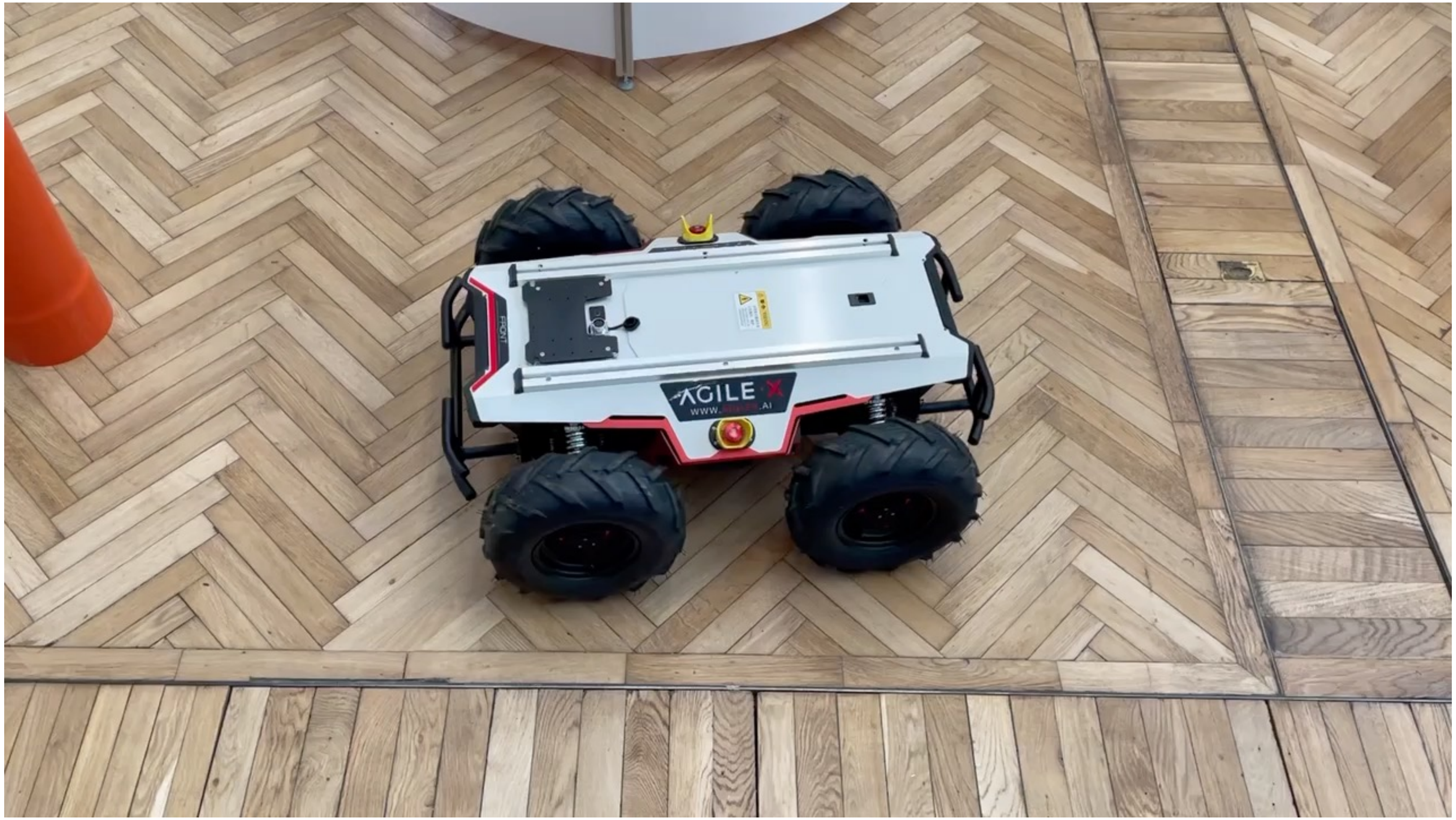
Unmanned ground vehicle (UGV)

Skid steering

4 Motors (1 for each wheel)

Links: Webpage, User Manual

THE ROBOT



Disclaimer: this video is only for demonstrational purposes. It does NOT show the actual path followed by the robot during our data acquisition.

THE PROJECT

Given:

- 4 motor speed (RPM)
- simple odometry provided by the manufacturer
- ground truth pose of the robot (acquired with OptiTrack)

THE PROJECT

Goals:

I. compute odometry using skid steering (approx) kinematics
   - using Euler and Runge-Kutta integration
   - ROS parameter specifies initial pose

II. use dynamic reconfigure to select between integration method

III. write 2 services to reset the odometry to (0,0) or to a pose(x,y,θ)

IV. publish a custom message with odometry value and type of integration

I. COMPUTE ODOMETRY

- Use message filters to synchronize motor speed messages
- Estimate linear and angular velocity of the robot from motors speed
  - You can use the manufacturer odometry to estimate the apparent baseline (required) and the gear ratio (optional)
    - ROS tools can help you here: rviz, rqt_plot, plotjuggler, …
  - Publish as geometry_msgs/TwistStamped
- Compute odometry with skid steering approx kinematics
  - Start with Euler, add Runge-Kutta later
  - A ROS parameter defines initial pose of the robot (x,y,θ)
  - Publish as nav_msgs/Odometry and TF
- Optional: use the ground truth pose to calibrate the apparent baseline for skid steering instead of the manufacturer odometry

II. INTEGRATION METHOD SELECTOR

- Use dynamic reconfigure to select the odometry integration method
- Use an enum with 2 values: Euler, Runge-Kutta

III. RESET SERVICE

- Define a service to reset odometry to (0,0)
- Define another service to reset odometry to any given pose (x,y,θ)

IV. CUSTOM MESSAGE

- Publish a custom message with prototype:

```
nav_msgs/Odometry odom
std_msgs/String method
```

- `method` can be either `"euler"` or `"rk"`

DATA

ROS bag file, with topics:

- motor speed for all 4 motors (f: front, r: rear; r: right, l: left)
  - /motor_speed_fr – robotics_hw1/MotorSpeed
  - /motor_speed_fl – robotics_hw1/MotorSpeed
  - /motor_speed_rr – robotics_hw1/MotorSpeed
  - /motor_speed_rl – robotics_hw1/MotorSpeed

Custom message, given

- simple odometry provided by the manufacturer
  - /scout_odom – nav_msgs/Odometry
- Ground truth pose of the robot (acquired with OptiTrack)
  - /gt_pose – geometry_msgs/PoseStamped

DATA

Additional information:

- Wheel radius: 0.1575 m
- Real baseline: 0.583 m (This is the actual distance between a pair of left and right wheels. The skid steering *apparent baseline* will be larger than this.)
- Apparent baseline: you will have to calibrate it ☺
- Gear ratio: ~~as in the robot manual~~ to be calibrated (optional)
  - Between 1:35 and 1:40

DATA

Files provided:

- 3 ROS bag with data:
  - Use bag1 as main data source
  - Use bag2 and bag3 to double-check
- Package `robotics_hw1` with:
  - message definition for msg `MotorSpeed`