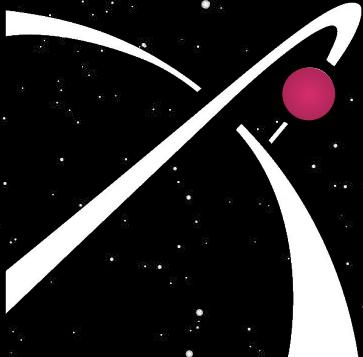


Above and Beyond

UNVEILING 23⁺

Thursday, May
25th 2023,
Forum Rôlex,
EPFL

■ MAKE
projects



Above and Beyond

UNVEILING 23⁺

Thursday, May
25th 2023,
Forum Rôlex,
EPFL

■ MAKE
projects

Emile Hreich

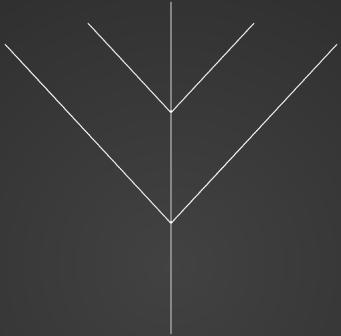
President

Cybersecurity Master's Student

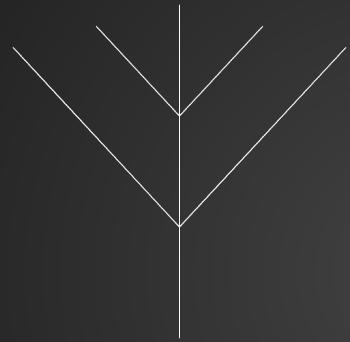




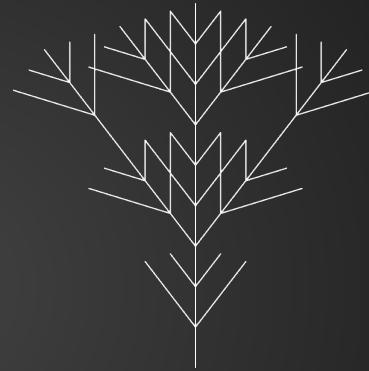
(E)XPLORER - PROLOGUE



Curiosity



Curiosity



Exploration





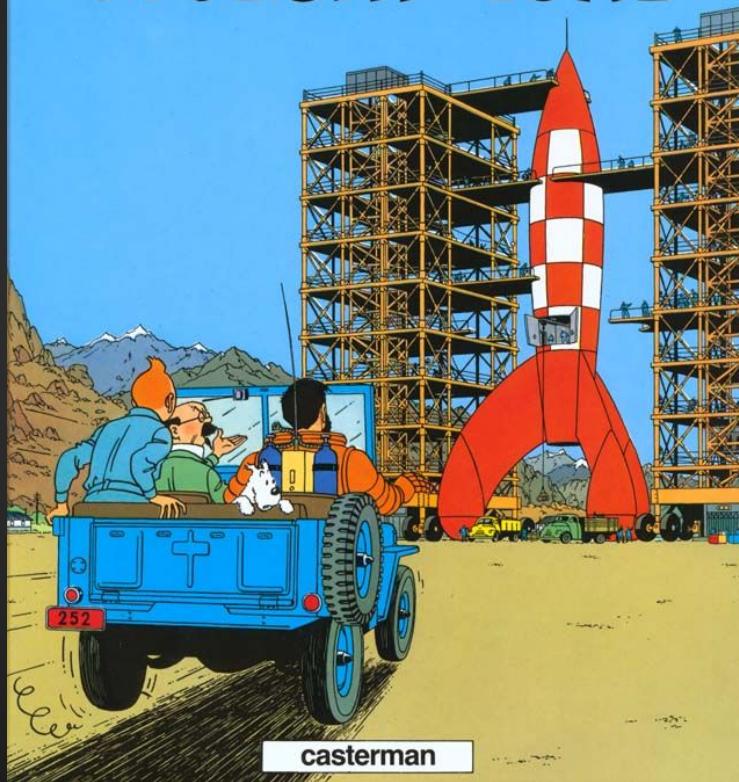
- HERGÉ -

LES AVENTURES DE

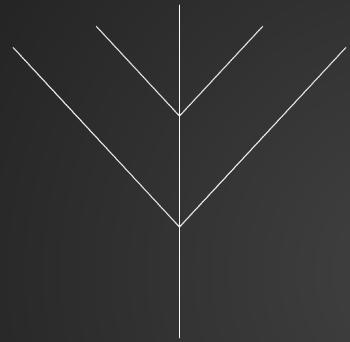
TINTIN

*

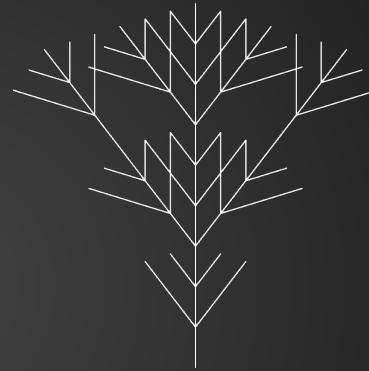
OBJECTIF LUNE



casterman



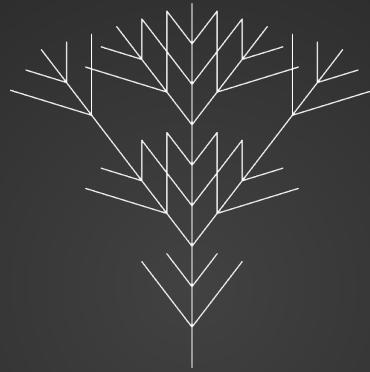
Curiosity



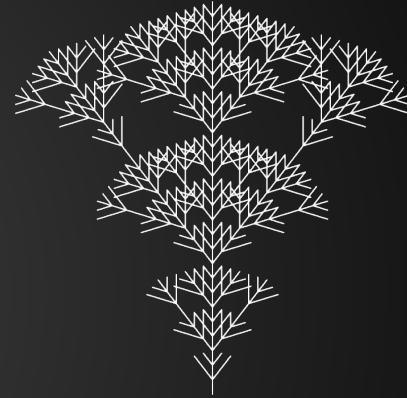
Exploration



Curiosity



Exploration



Makers

2020



2021



2022



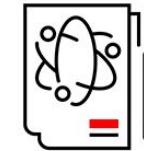
An example of interaction between students,
research and industry



Project-based
Learning



Innovation



Research



Gloria Mellinand

Vice-president & Project Manager

Robotics Master's Student





Project Drone: Brokkoly



Science

Presentation



Navigation

Maintenance



President
Emile H.

VP & PM
Gloria M.

CFO
Louis F.

Systems Engineers

**SE
Mechanics**
Grégoire L.

SE Software
Roman D.

**SE
Electronics**
Vincent N.

**SE
Electronics**
Yassine B.

SE Drone
Arion Z.

Team Leaders

**Control
Station**
Evan M.

Navigation
Xavier N.

**Handling
Device**
Ali E.

Science
Mathieu S.

Structure
Alexia D.

Electronics
Yassine B. &
Vincent N.

Drone
Arion Z.

Teaching hands-on engineering:

Xplore Rover Challenge



112'000
CHF



8
months

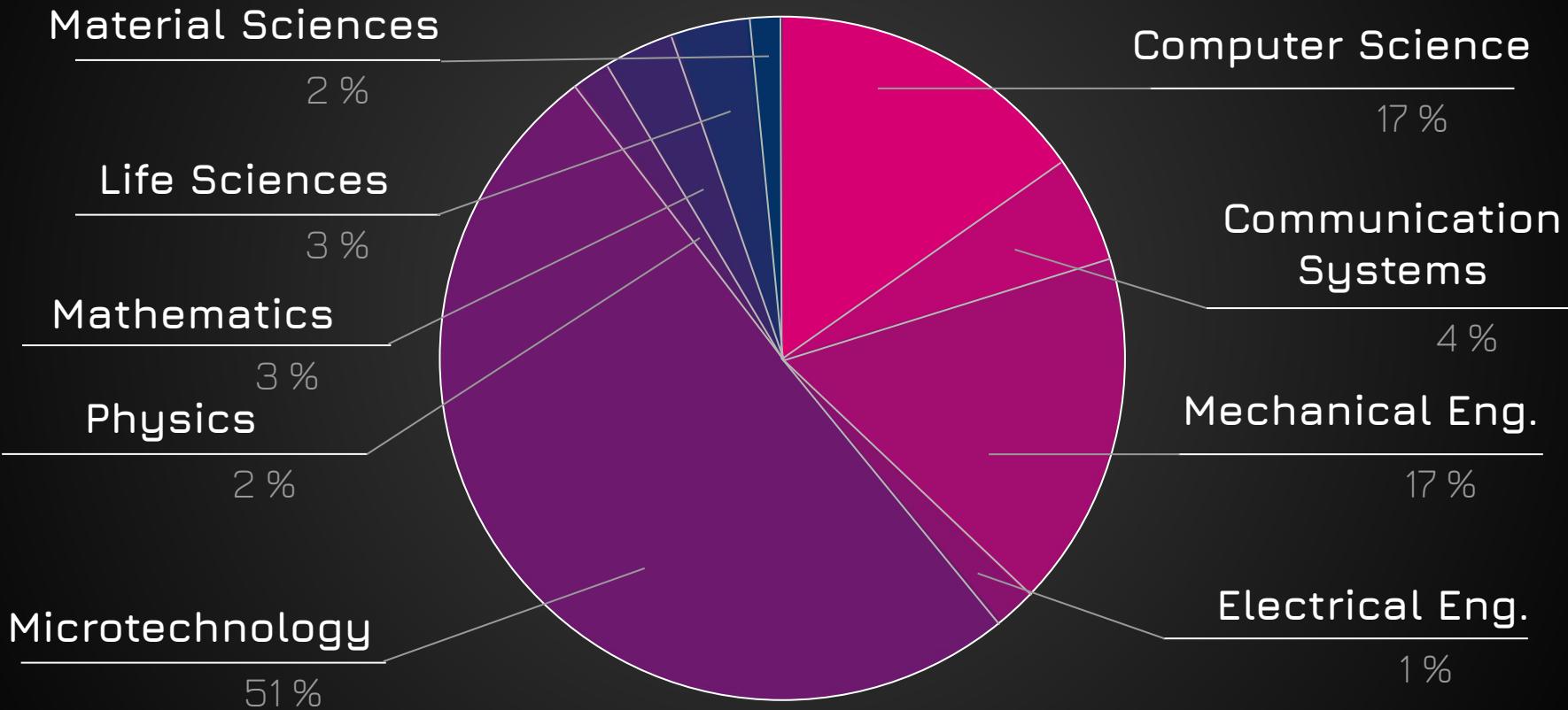


20'000
hours

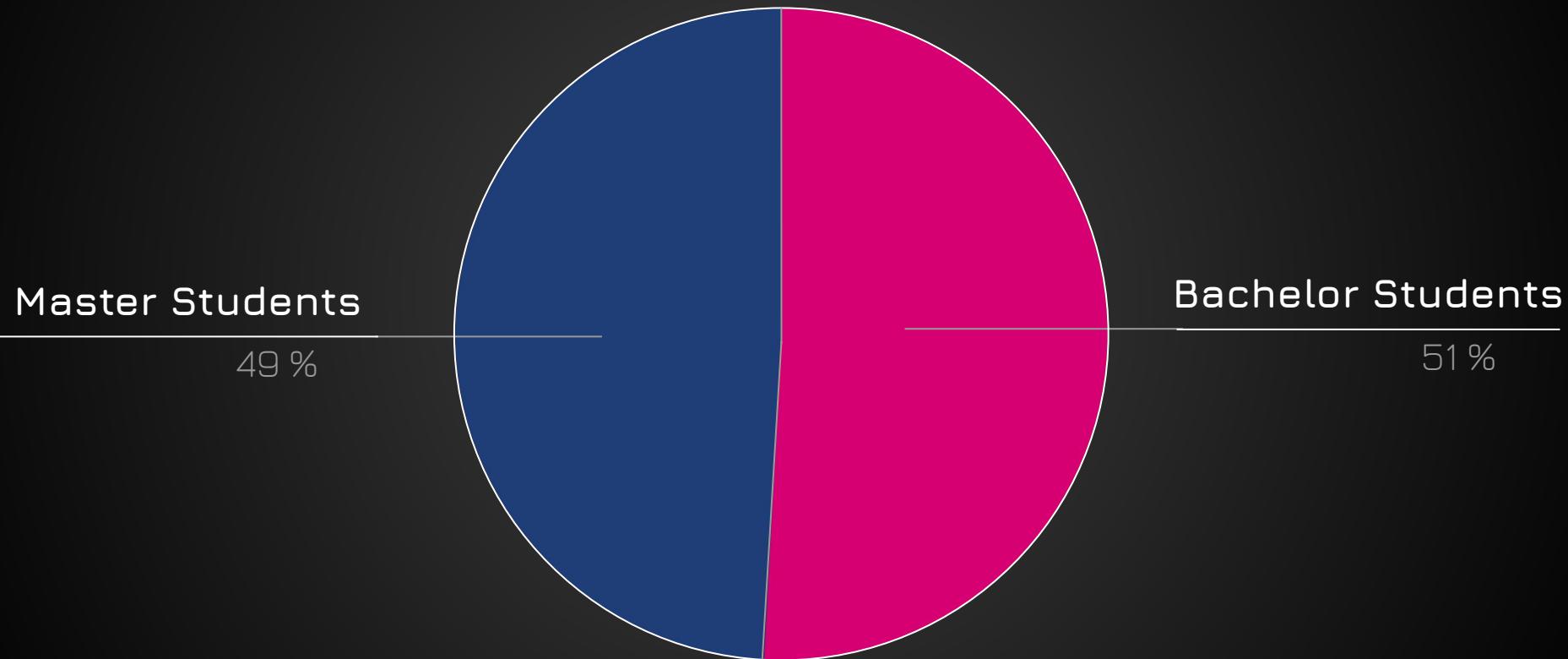


48
Members

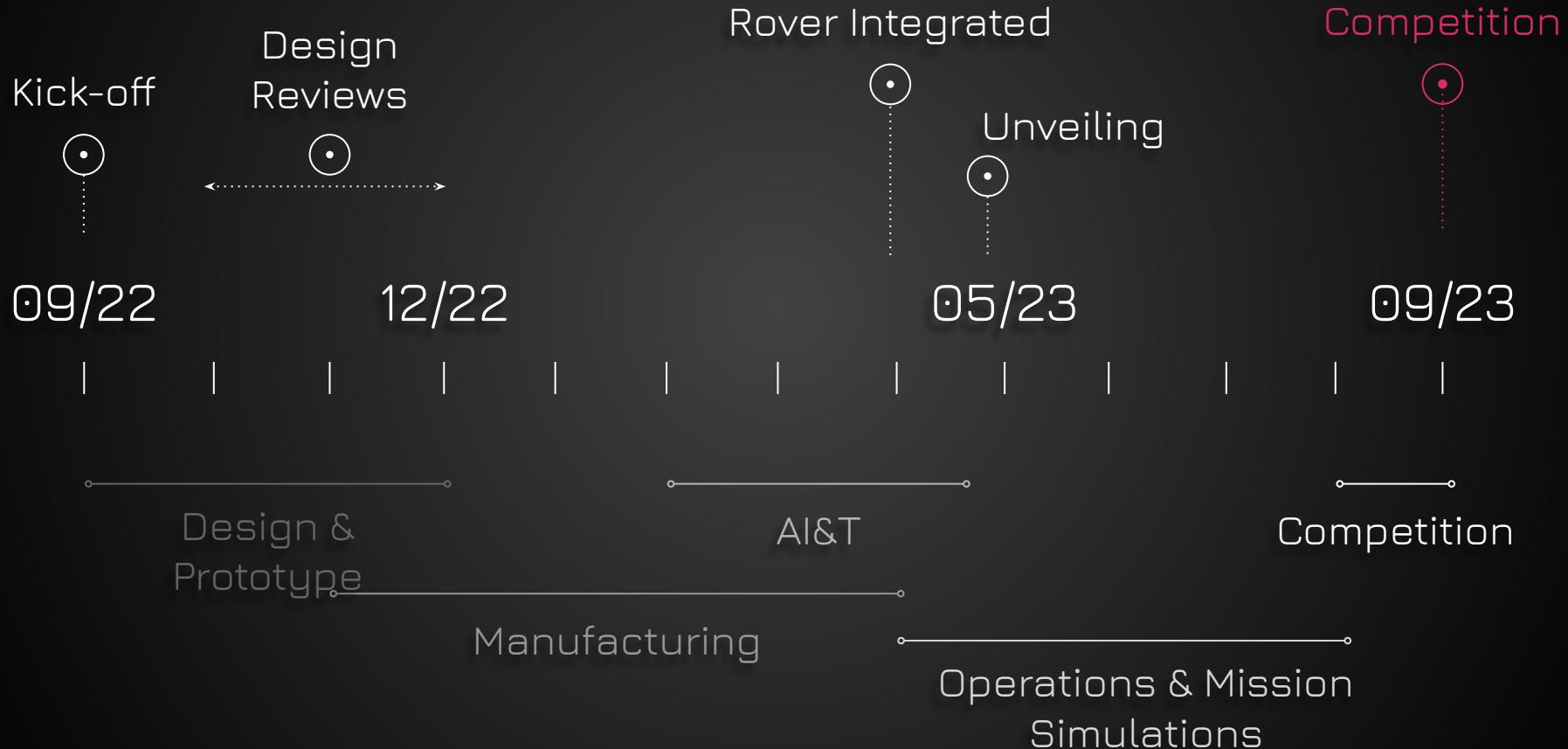
Academic Backgrounds



Academic Levels



Timeline



KERBY



3.0

EPFL XPLORER



ERC 2023



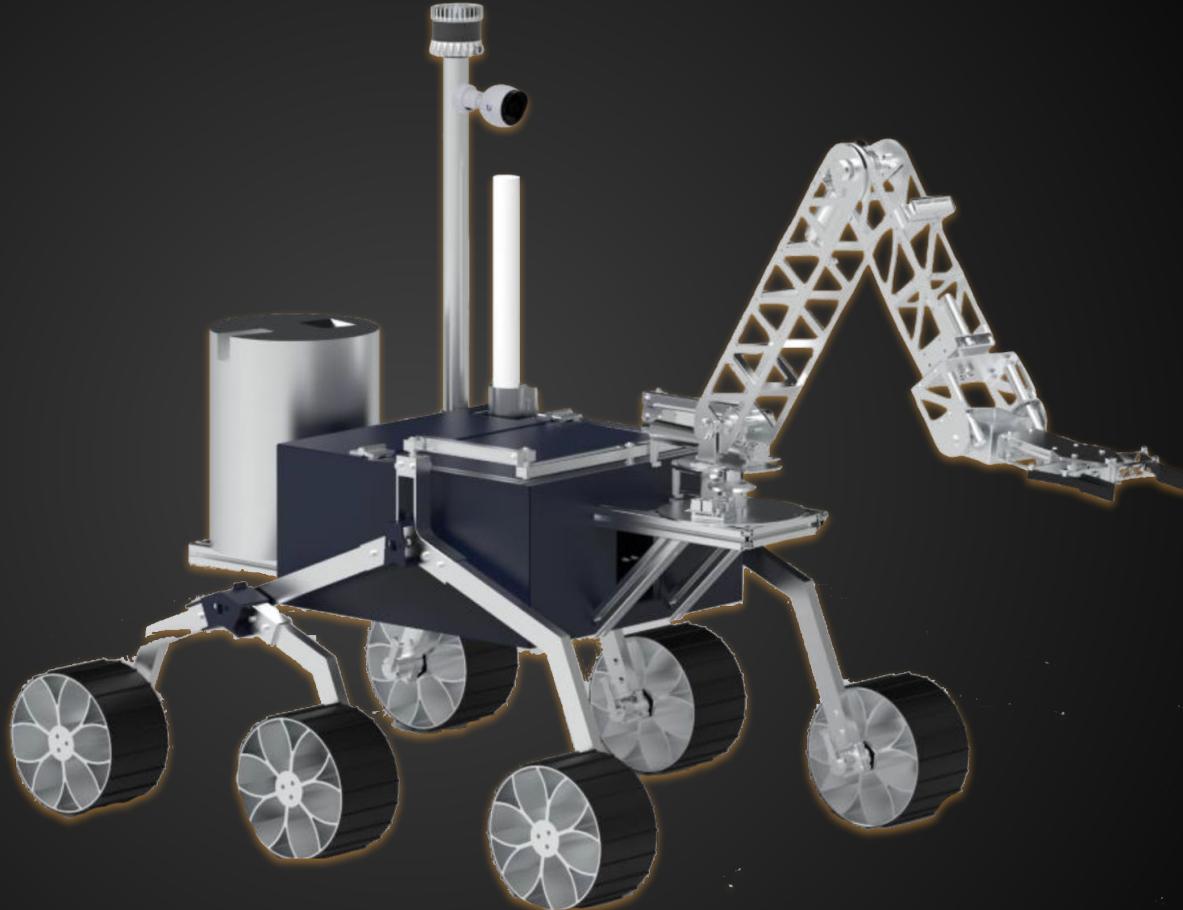
Grégoire Lacroix

Mechanical Systems Engineer

Microengineering Master's Student

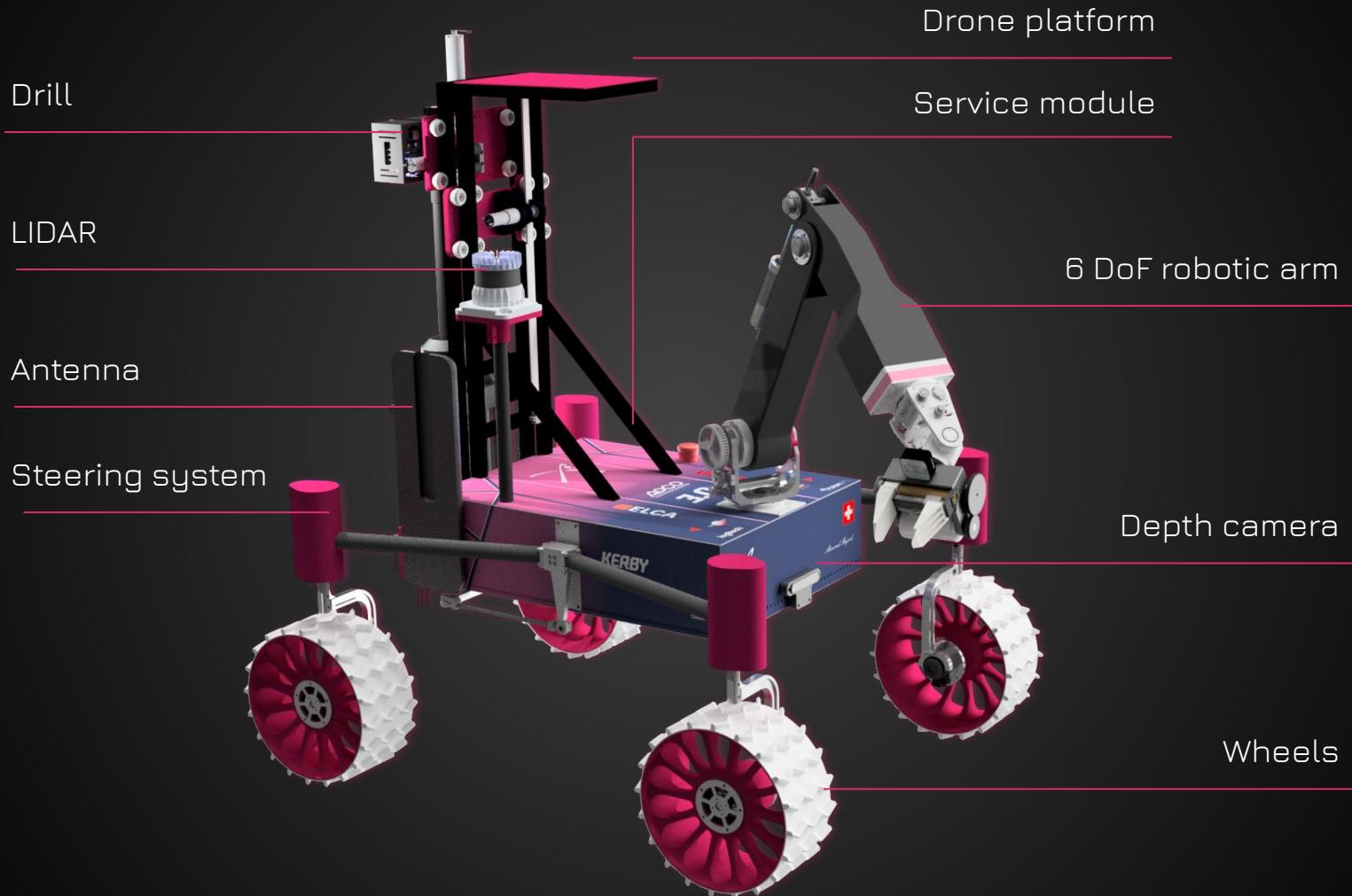


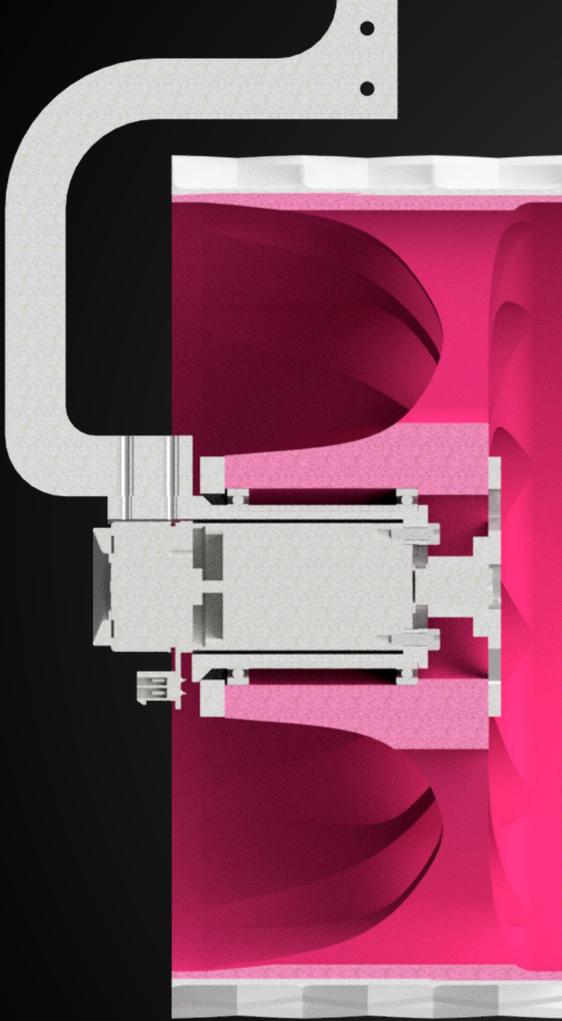
7.0



2.0



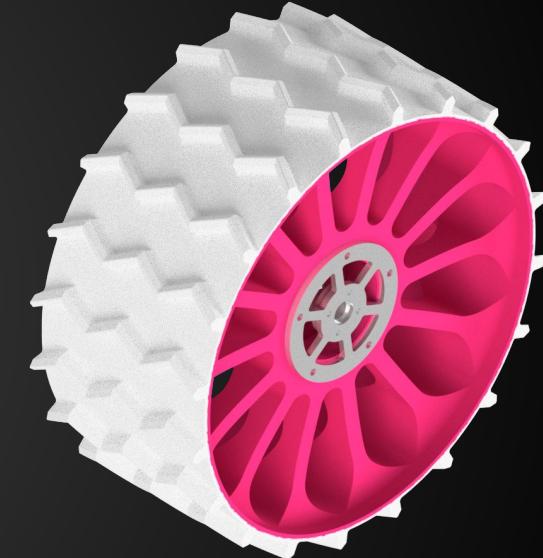




Wheels

Grip ensuring with
polyurethane coating

In-wheel motor



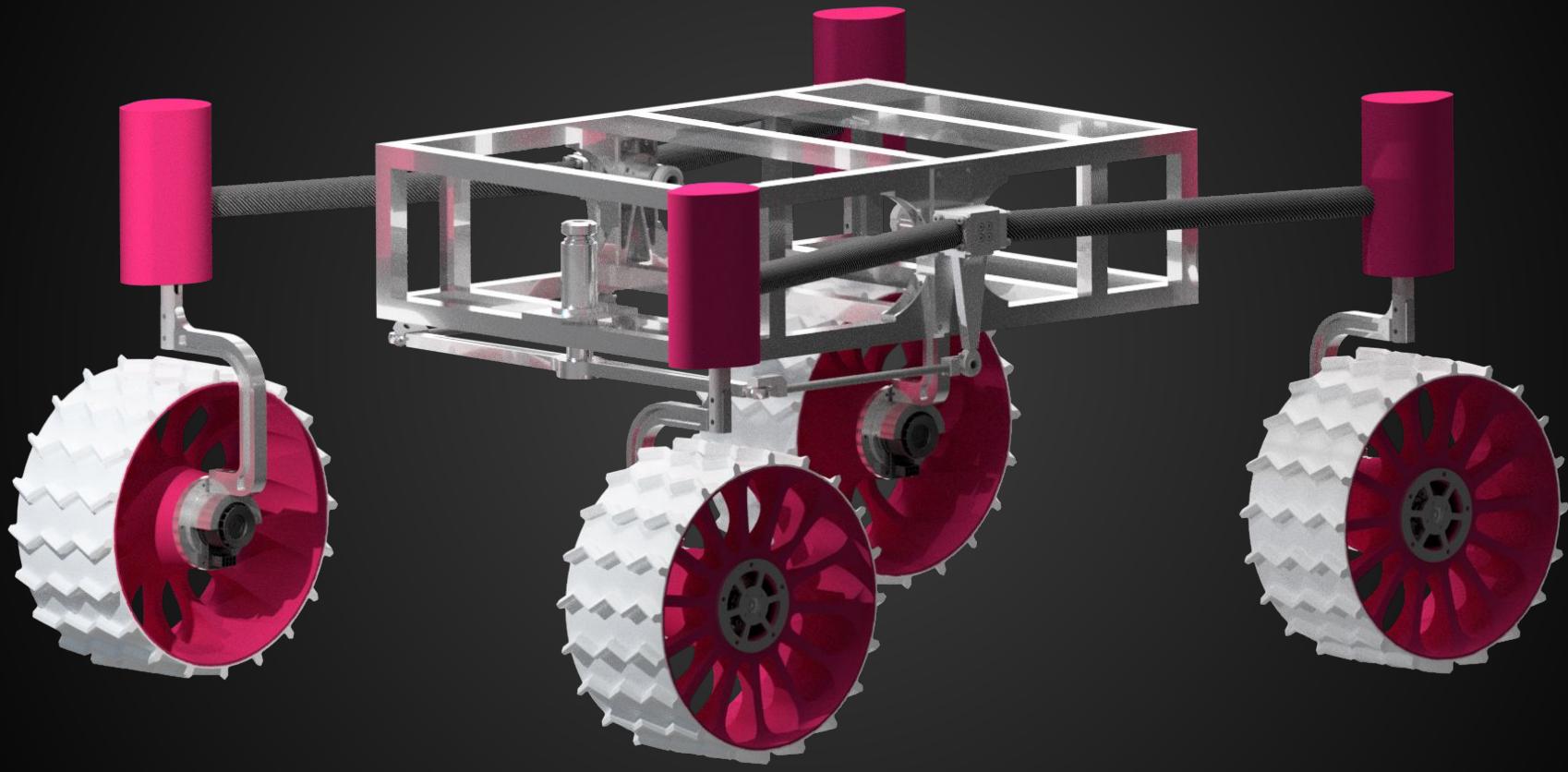
Steering system

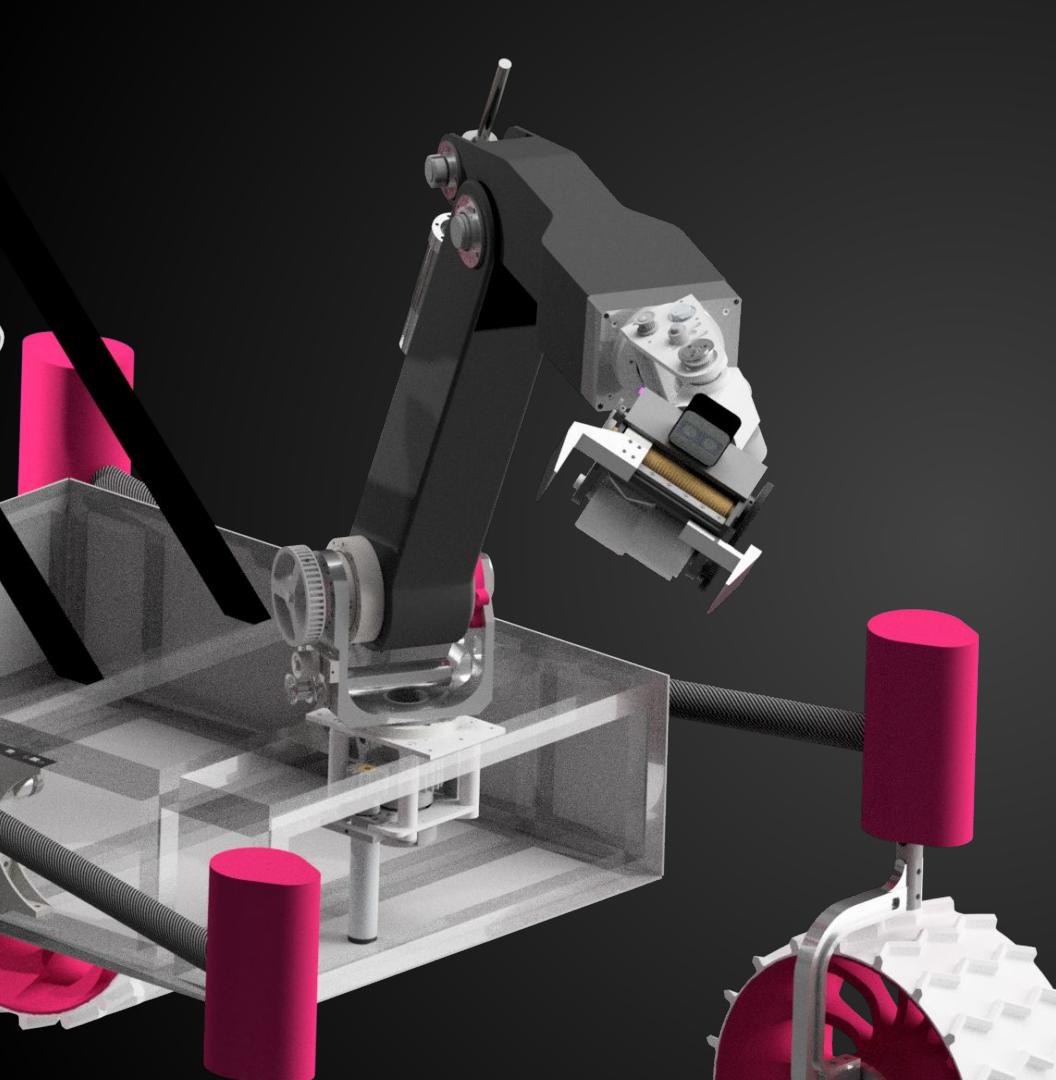
Infinite rotation

Output shaft absolute encoder

Maximal admissible torque 15Nm







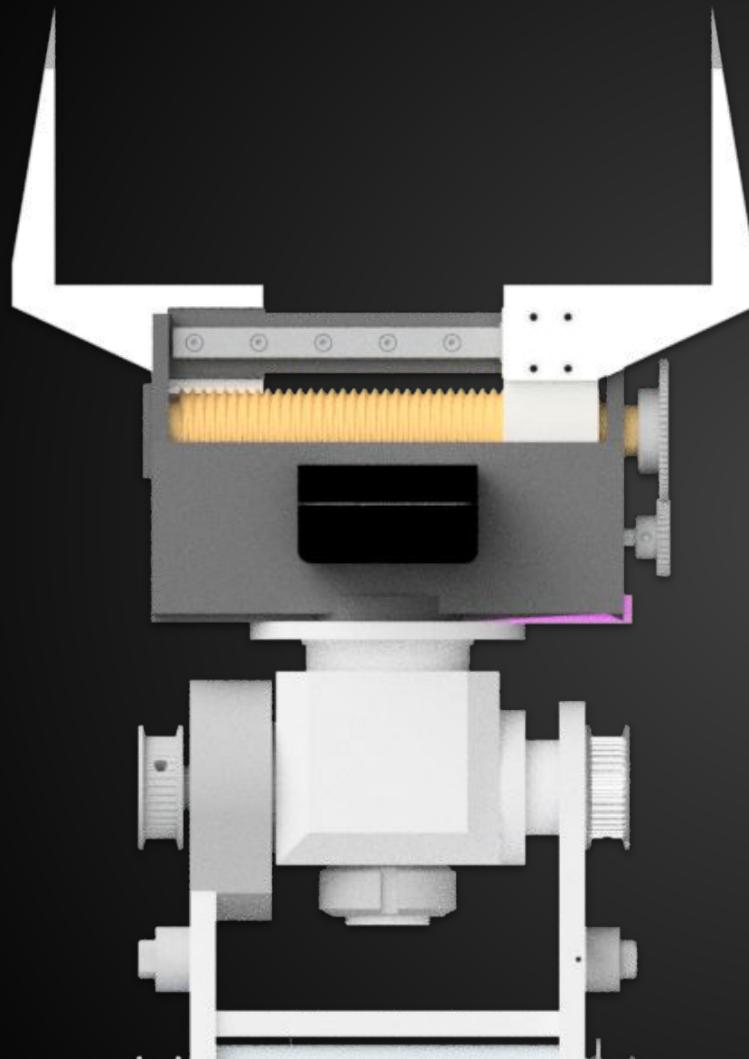
Robotic Arm

6 Joints

Harmonic drive

Ball screw

Carbon fiber links



Gripper

Two ways threaded screw
with nuts left and right
threads

Total stroke 150 cm

Depth camera

2 kg maximum load

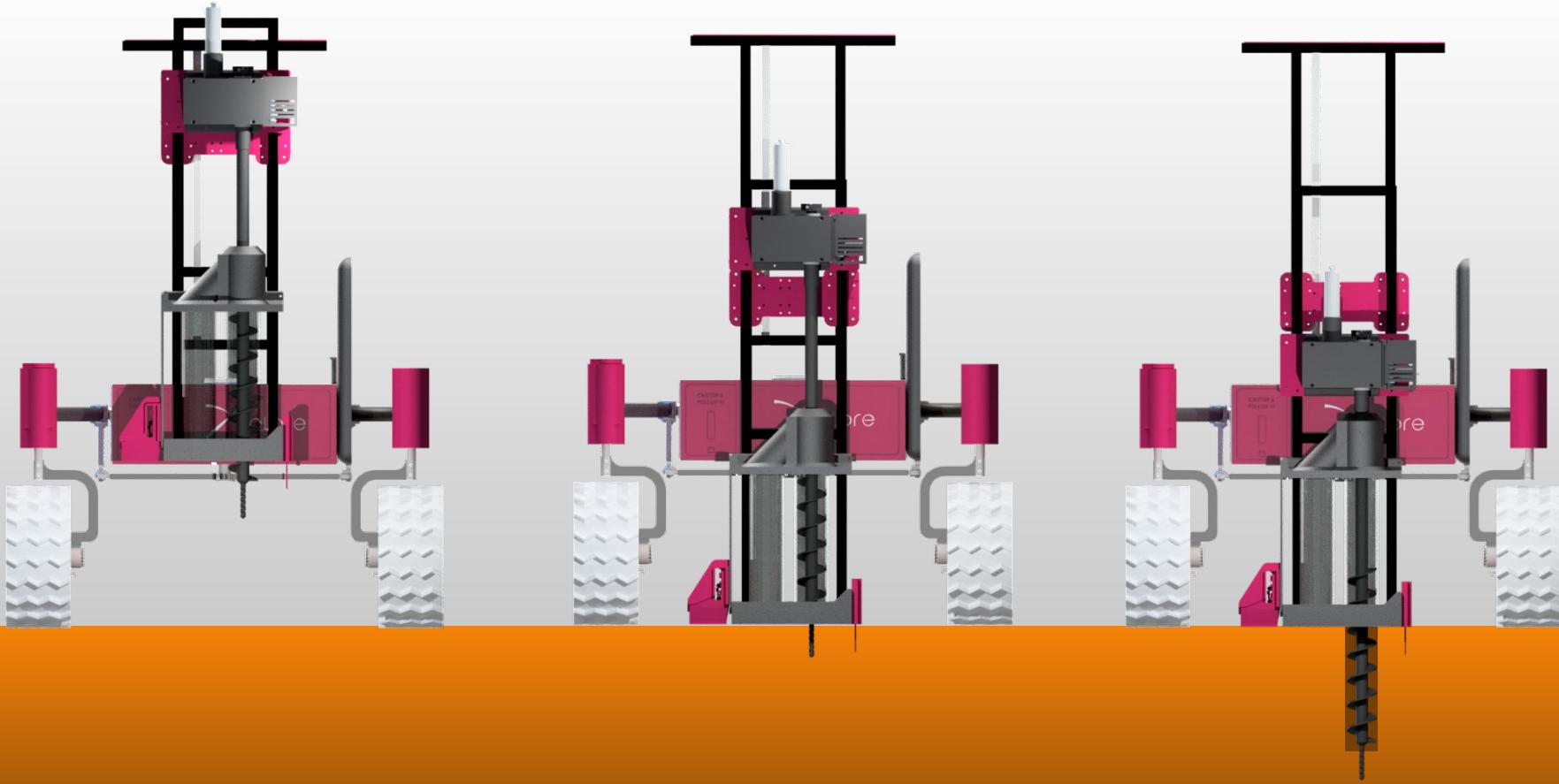


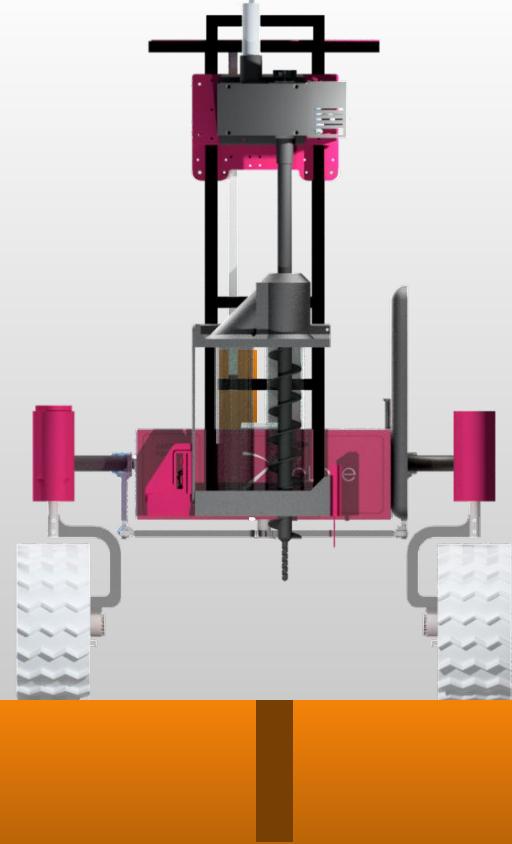
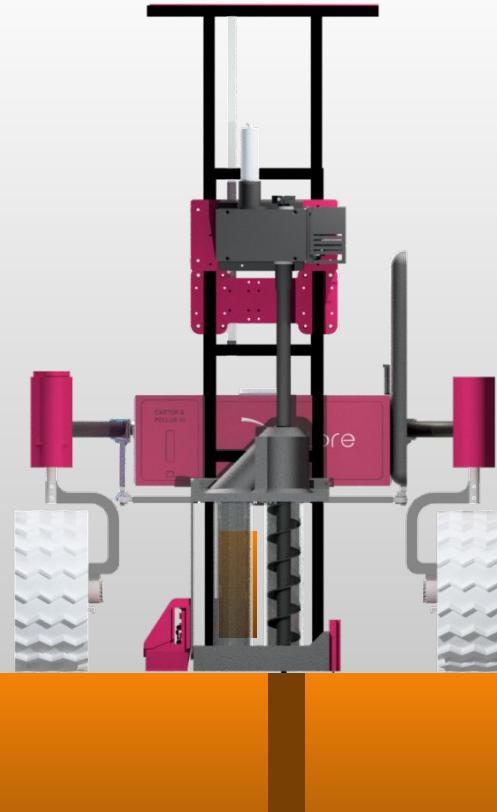
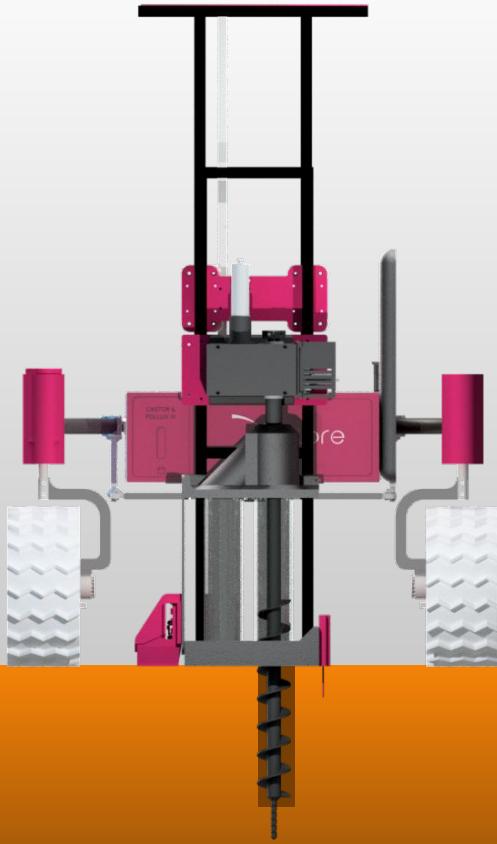
Drilling system

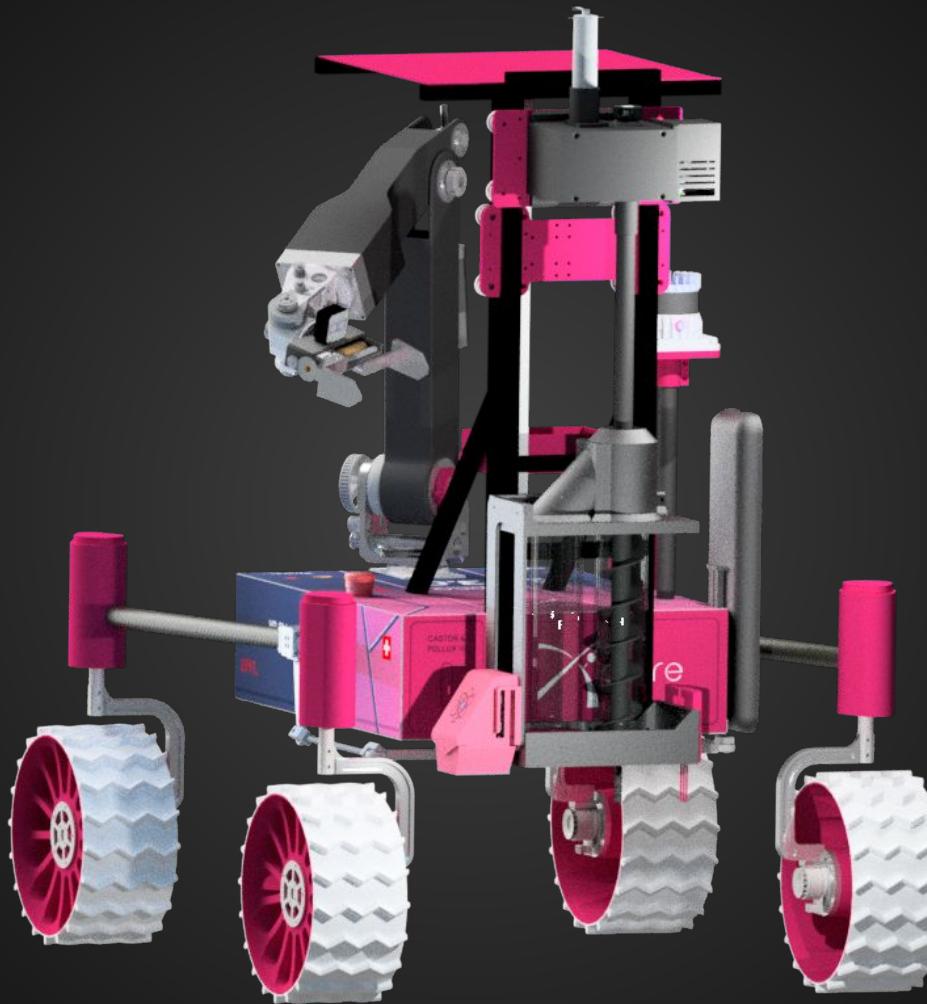
300 mm depth

60 mm diameter

Sand collection







Vincent Nguyen

Electronics Systems Engineer

Robotics Master's Student



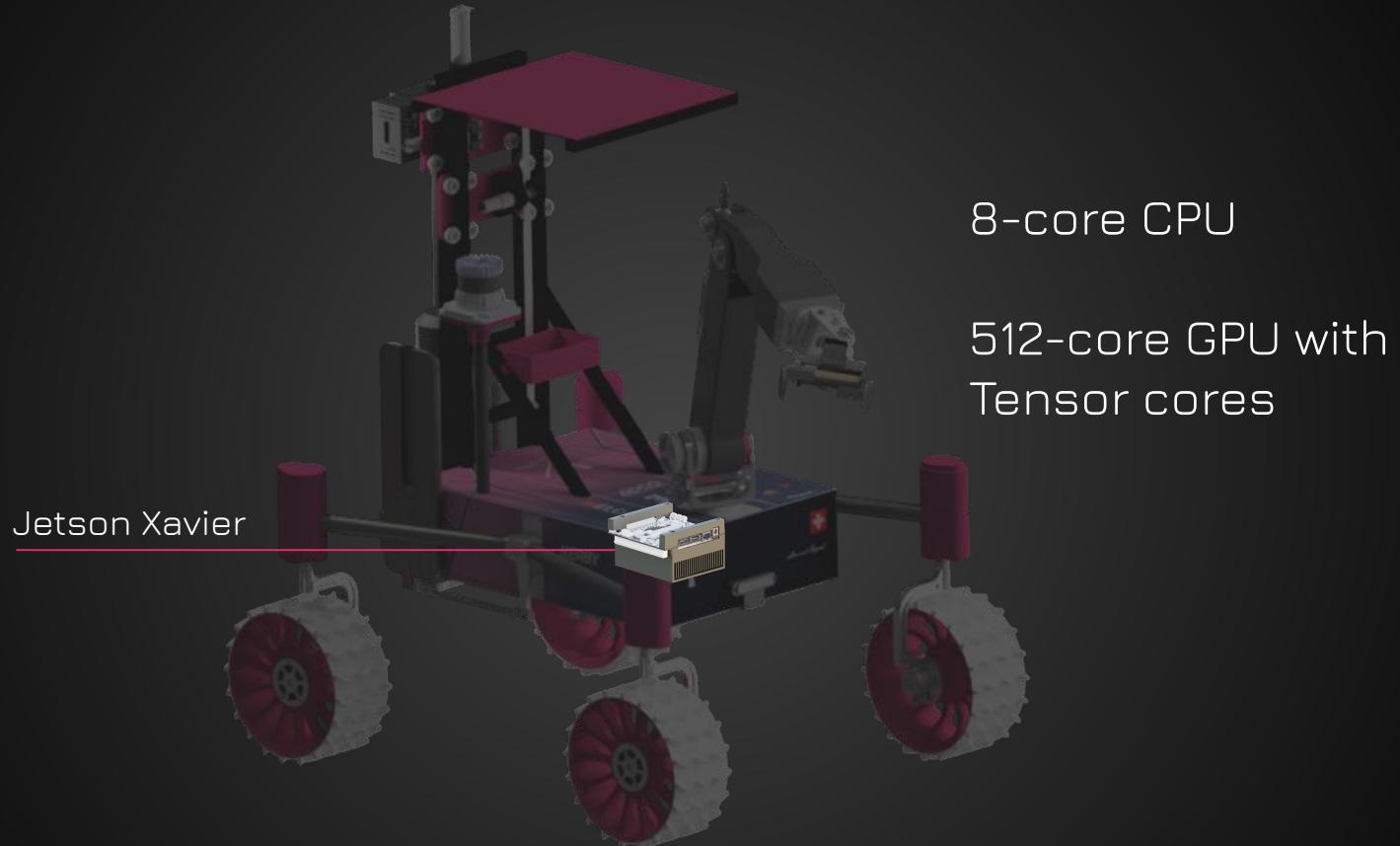
Robustness

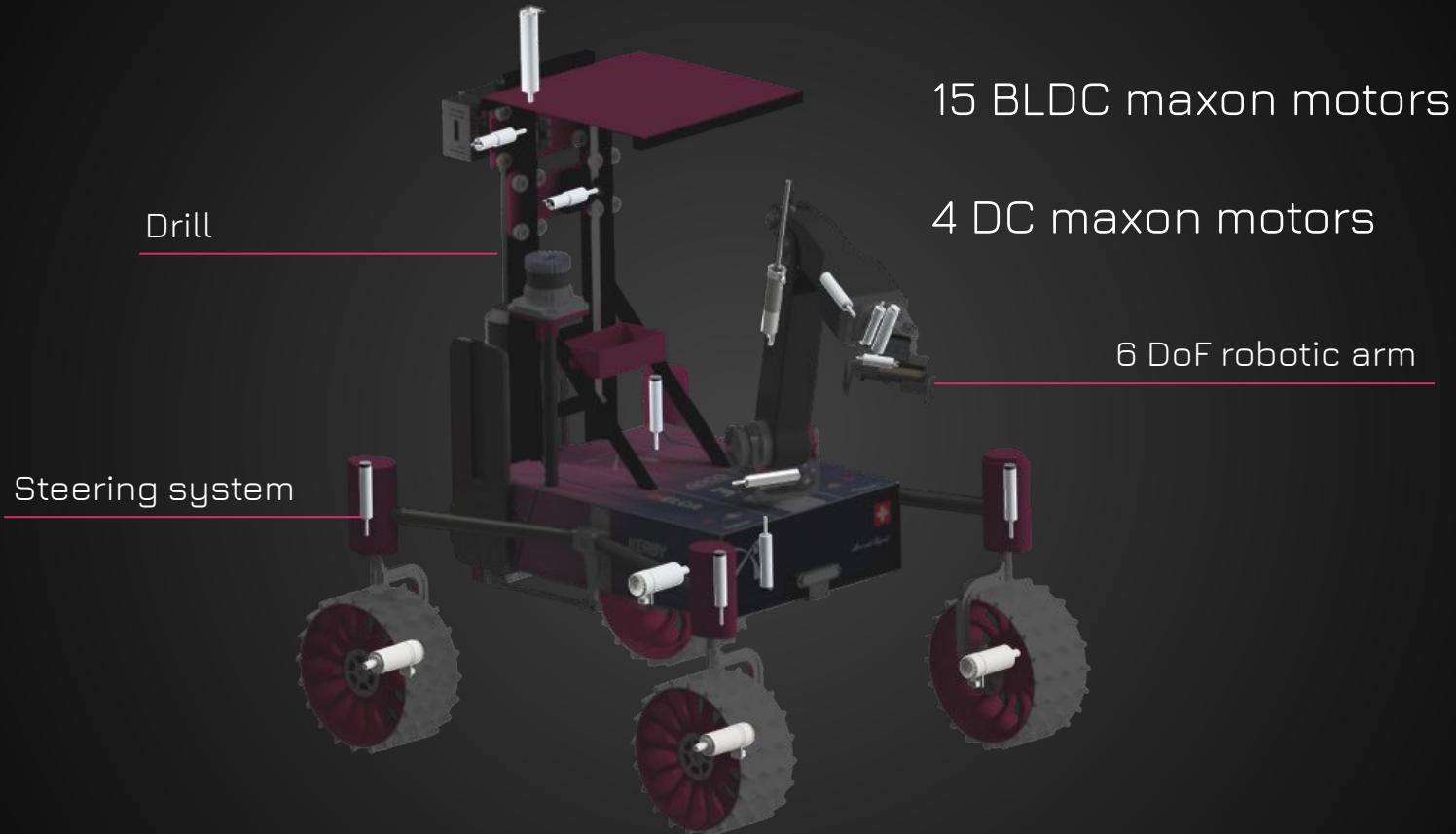


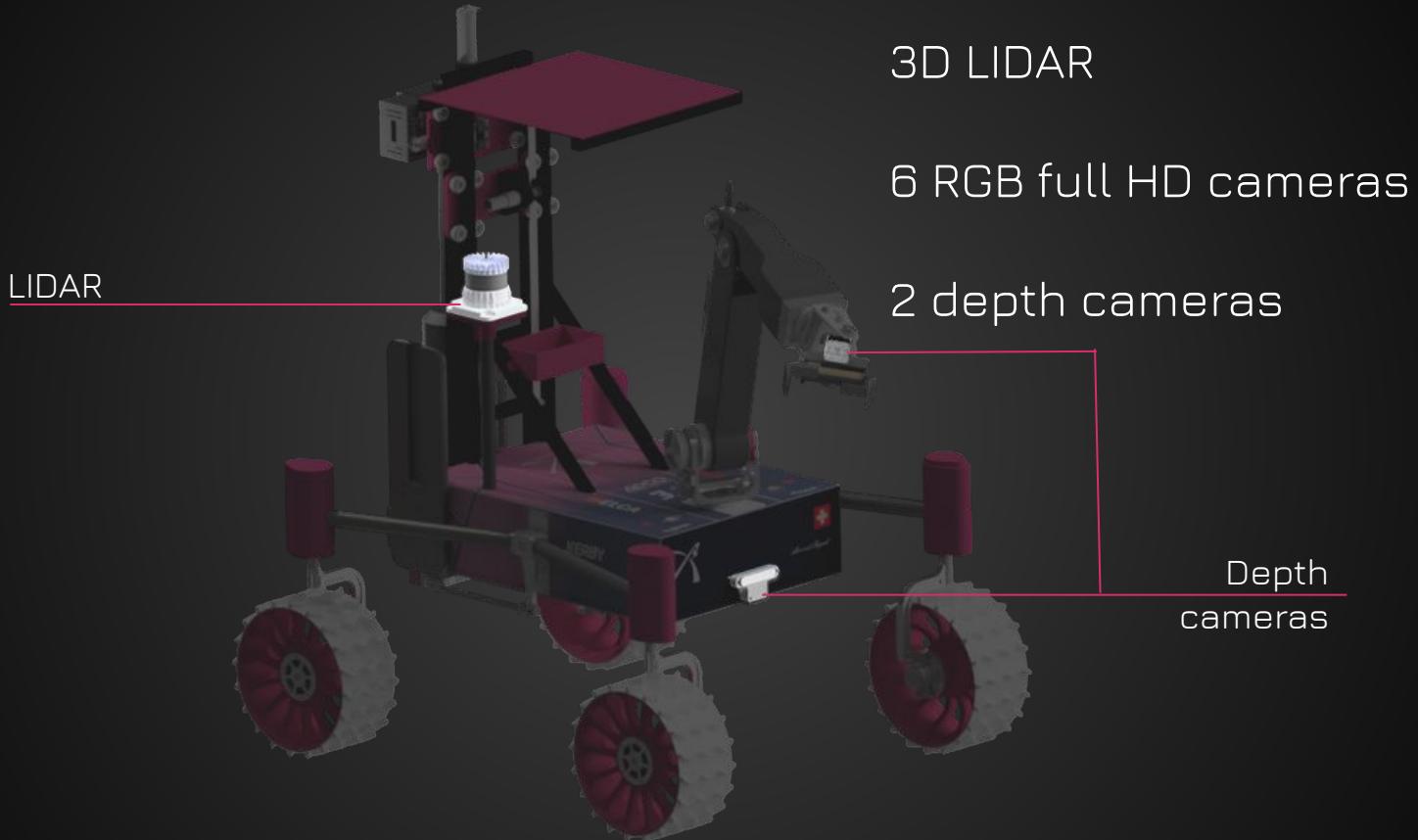
Redundancy

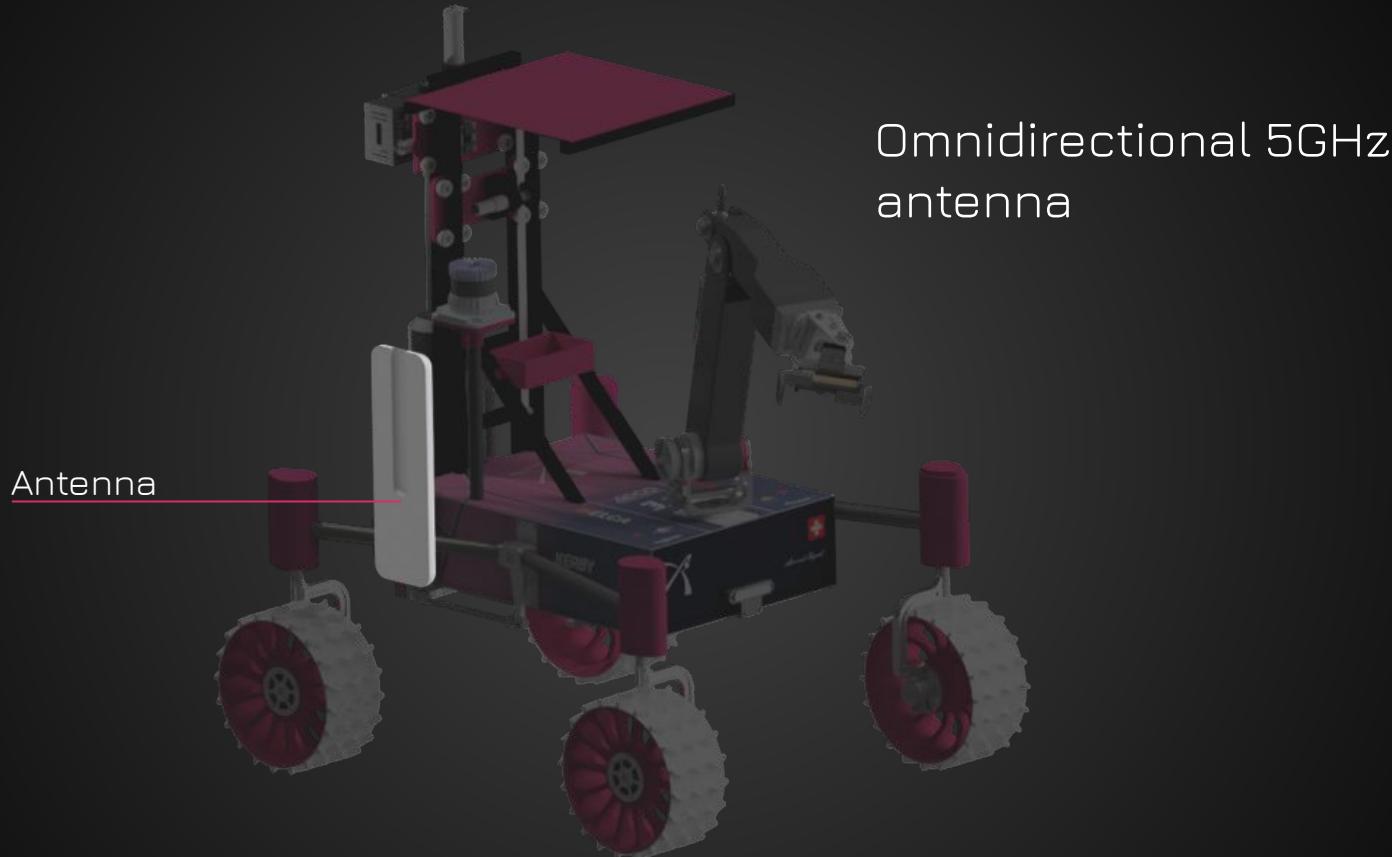
Modularity











Power source

600Wh

3+ hours of operation

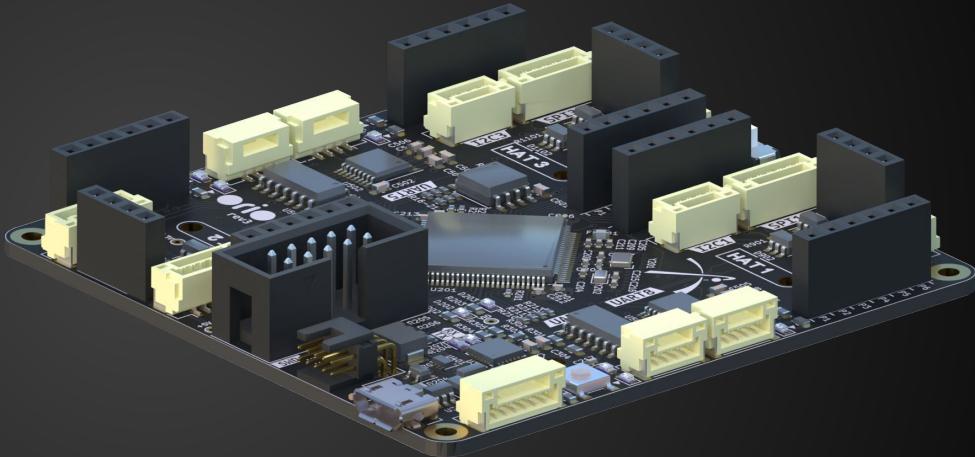


Orion v3

Redundant meshed
network

Modular sensor
modules

Independent power
supplies

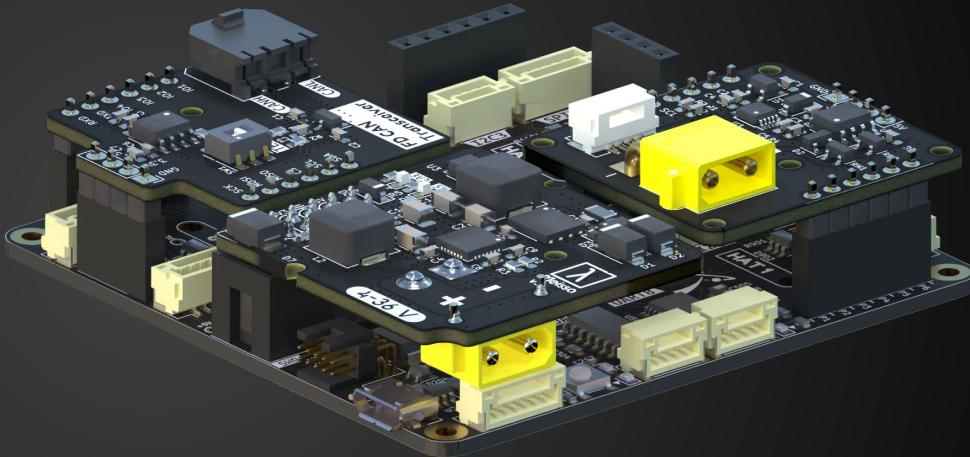


Orion v3

Redundant meshed
network

Modular sensor
modules

Independent power
supplies

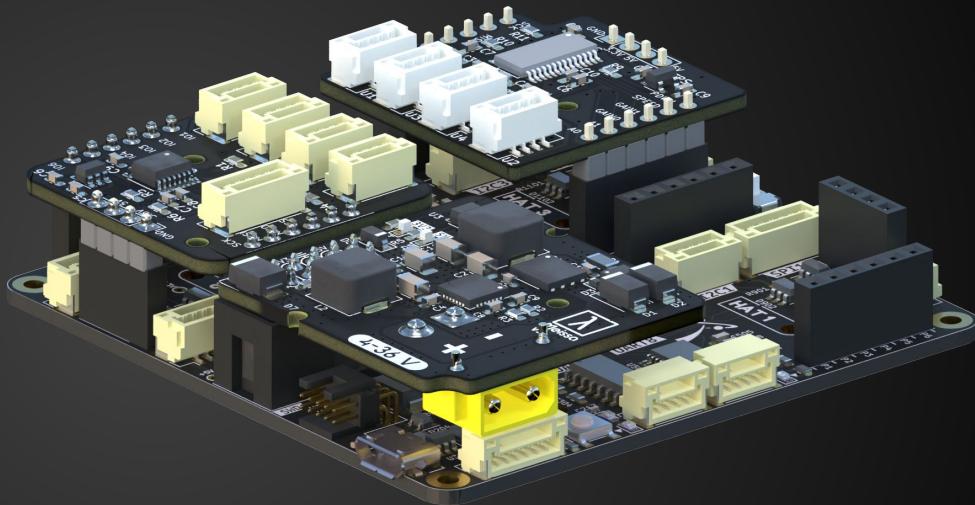


Orion v3

Redundant meshed
network

Modular sensor
modules

Independent power
supplies



Yassine Bakkali

Electronics Systems Engineer

Robotics Master's Student



Sensing capabilities

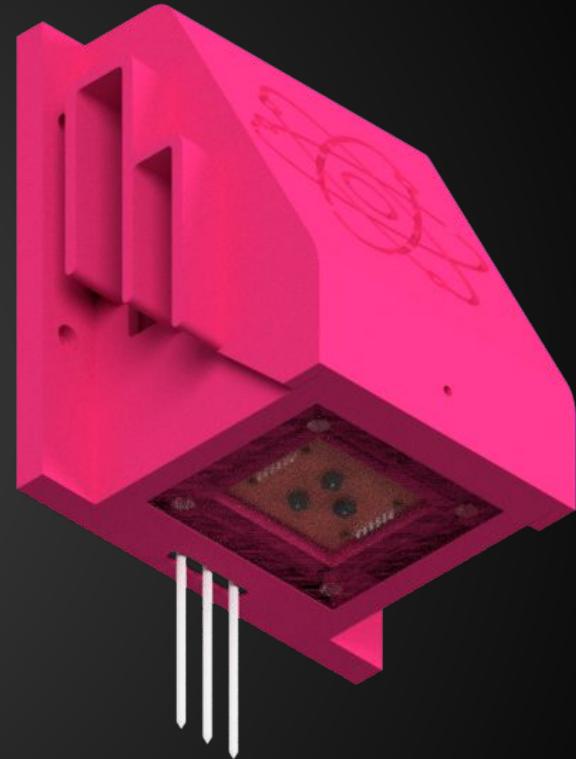
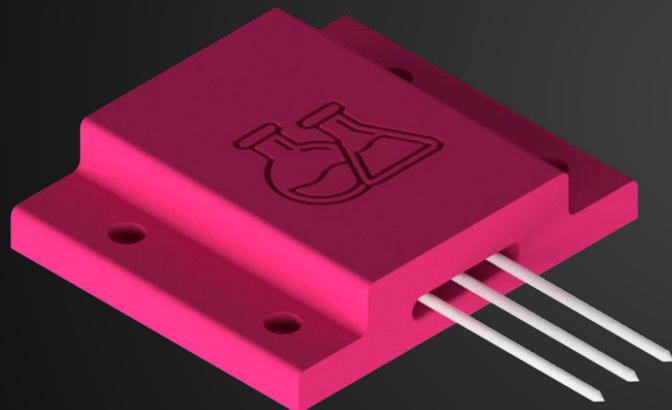
Precise mass measurements

Spectrophotometry

Soil nutrient sensors



Determining the quality of
the soil on Mars



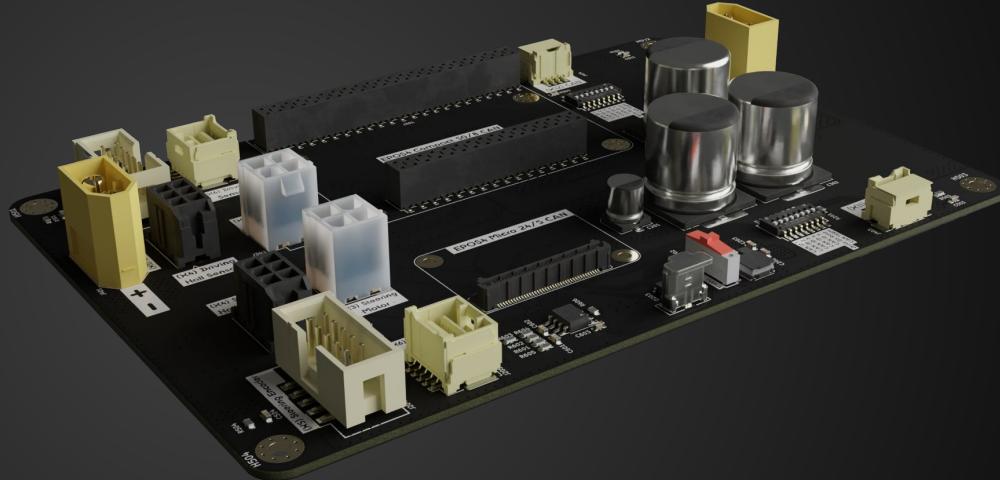
Motor control boards

2 maxon controllers

For steering and
drive motors

External absolute
encoder

Daisy-chained in
CAN bus

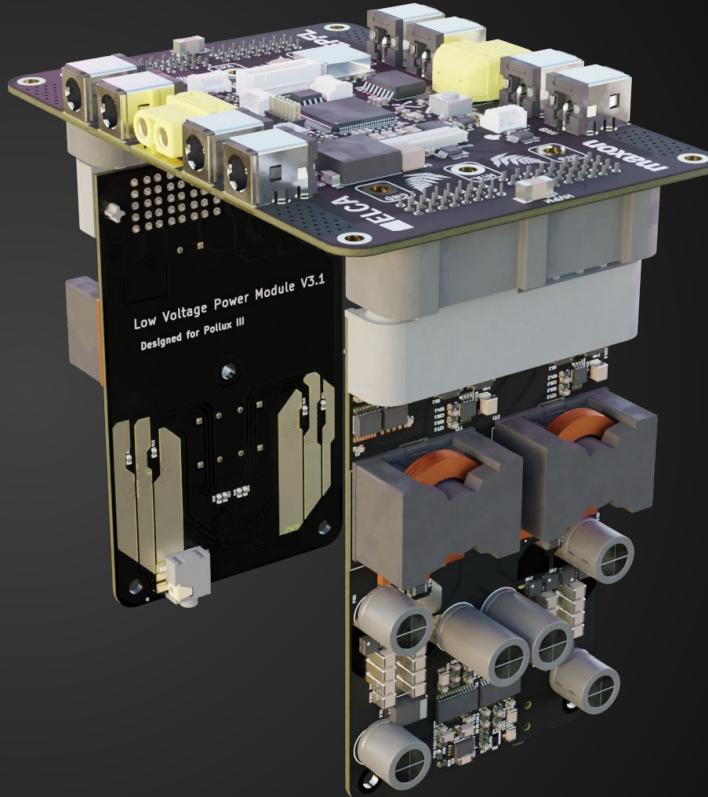


Pollux III

Fully parallelizable

4 programmable
voltage rails

Up to 15 amps per
channel







Roman Danylovych

Software Systems Engineer

Communication Systems Bachelor Student





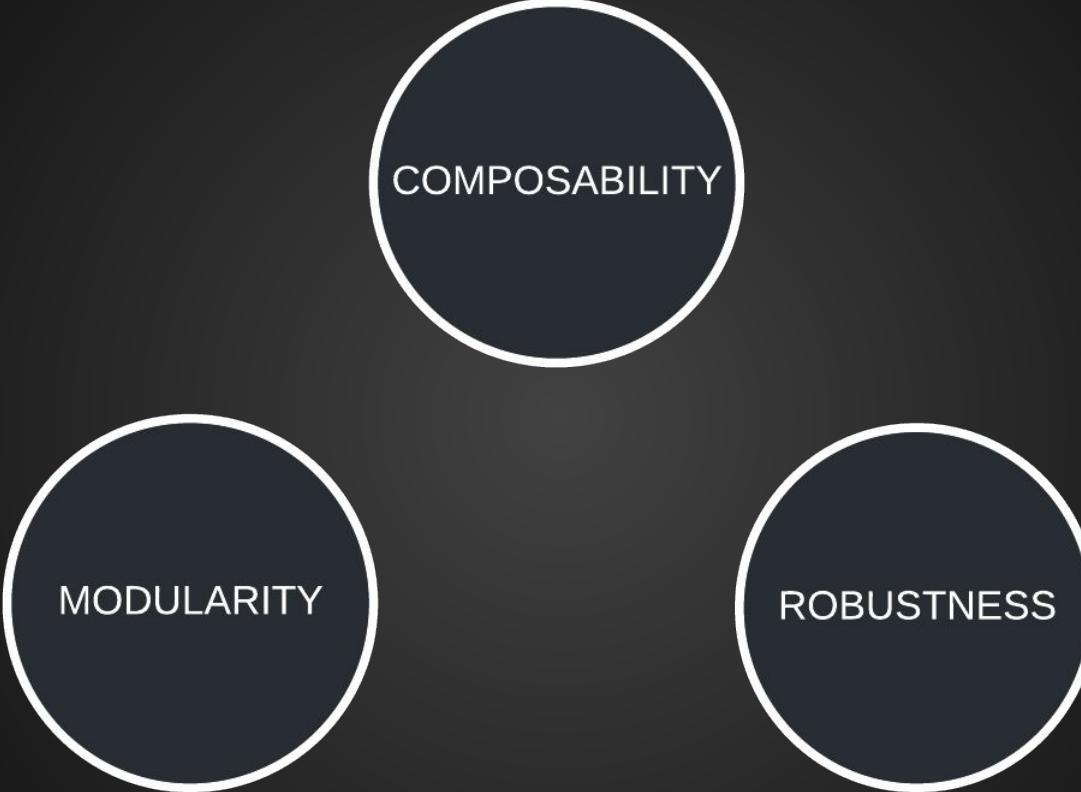
Start Rover



Documentation



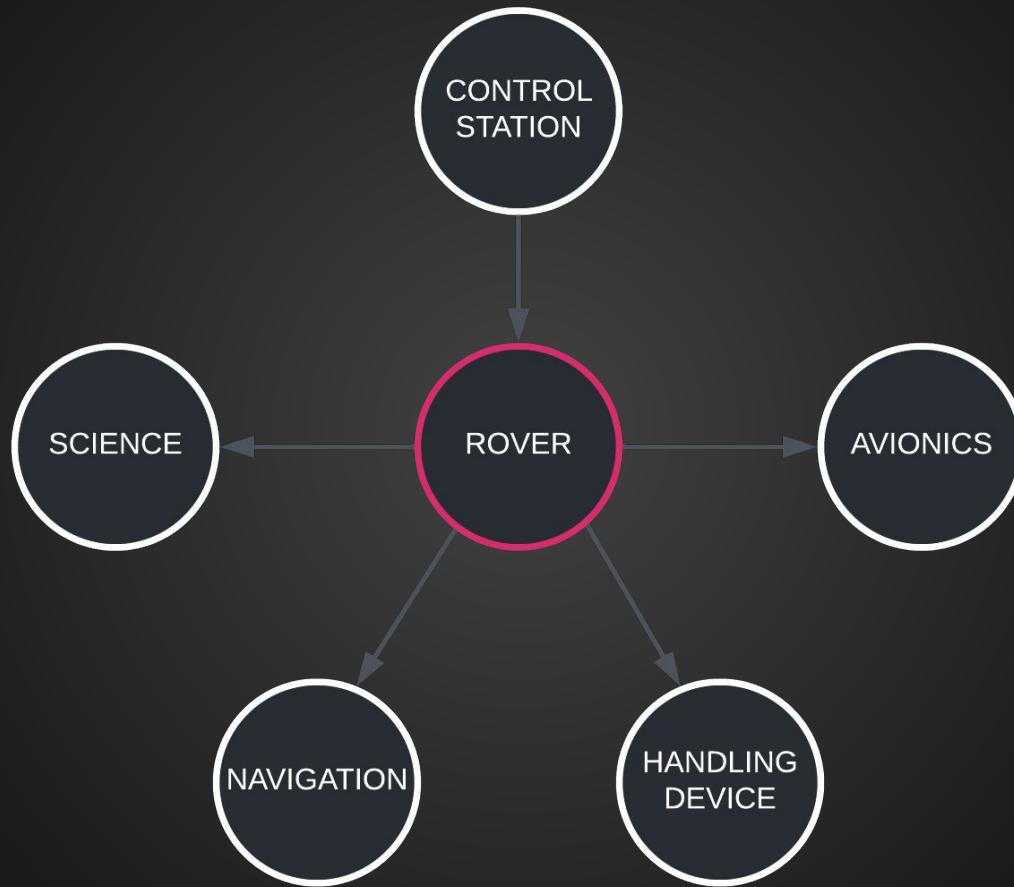
Drive



COMPOSABILITY

MODULARITY

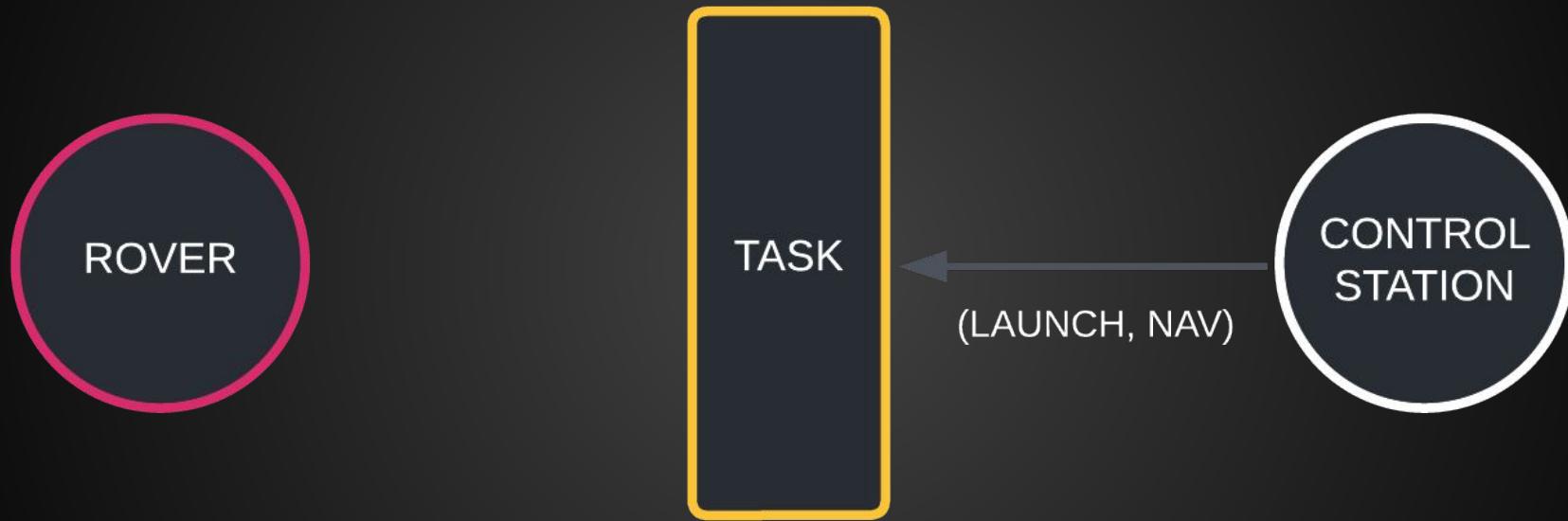
ROBUSTNESS



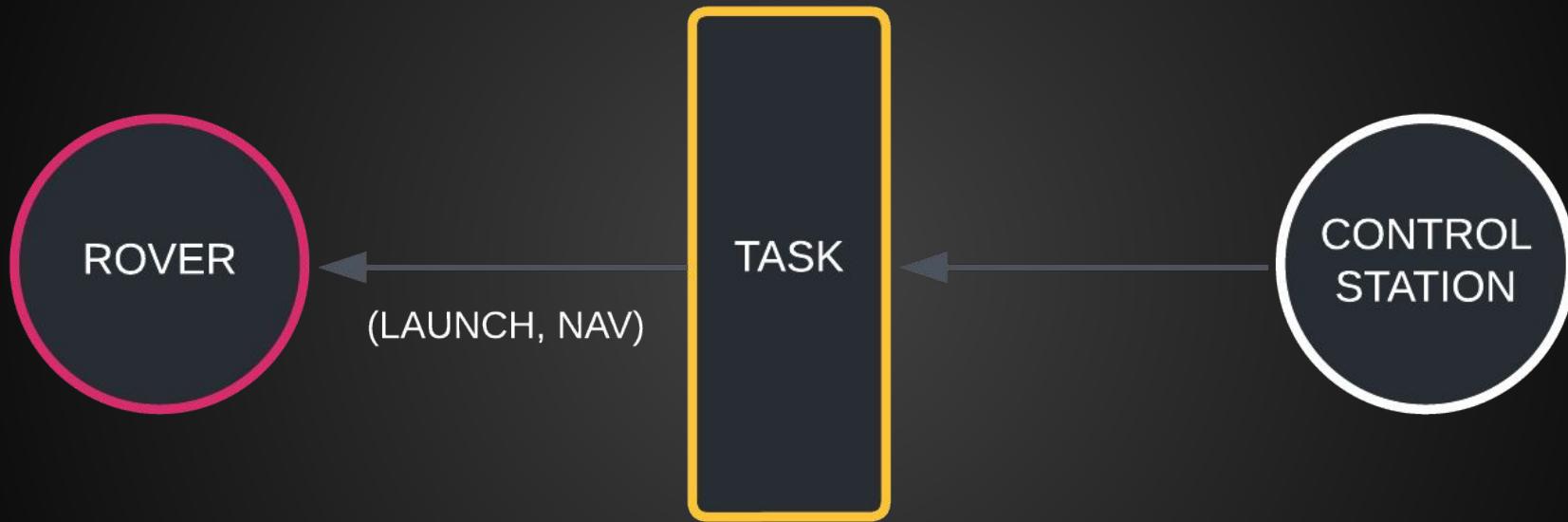
Robot Operating System



Robot Operating System



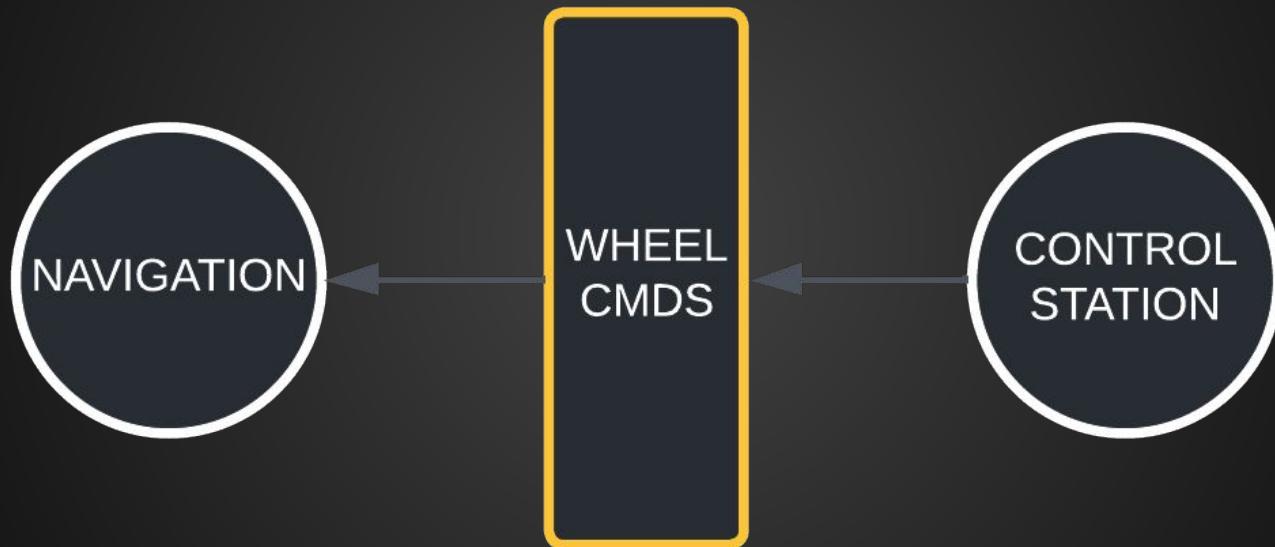
Robot Operating System



Robot Operating System



Robot Operating System



BDD

Subsystem: Control Station

Scenario: GUI functionalities

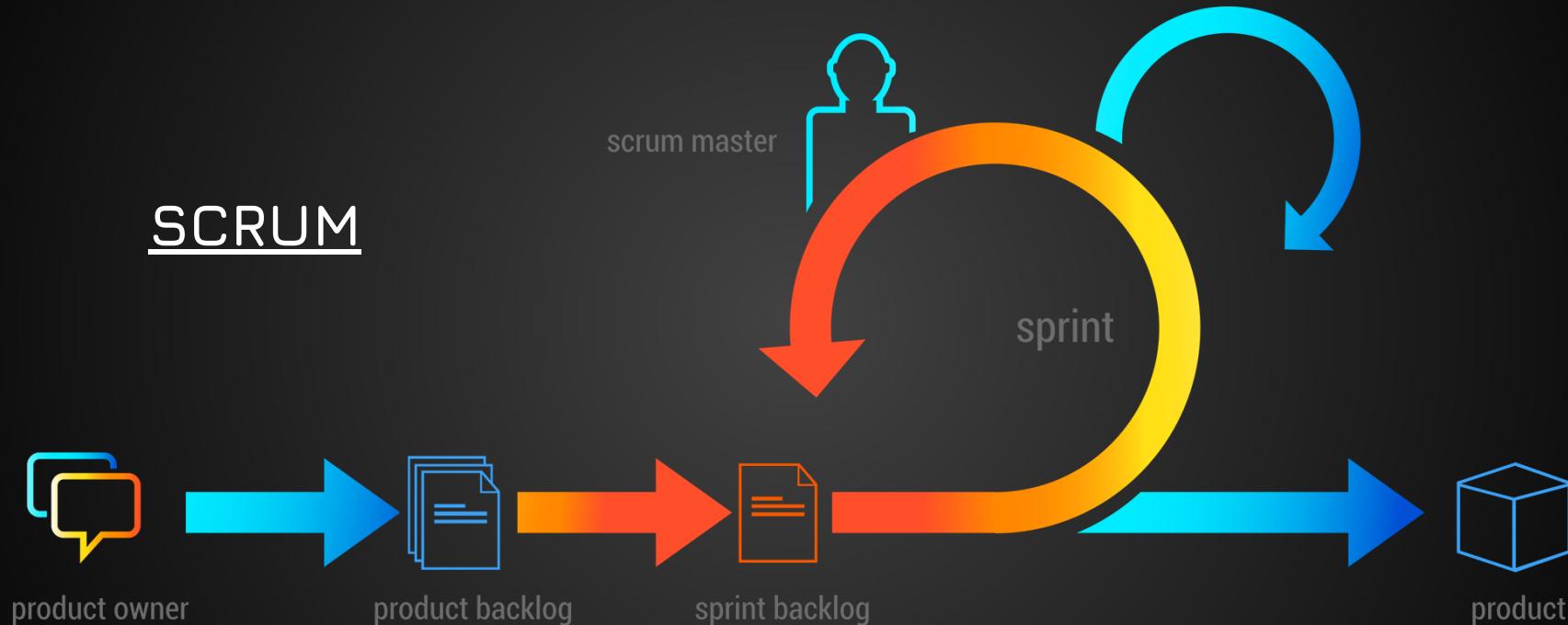
- **As the** operator
- **I must be able to** monitor in what state the rover is
- **So that** I am aware of what it is doing and the instructions I can send it

Subsystem: Handling Device

Scenario: Autonomous IK

- **The rover** shall be able to recognize a switch on the control panel
- **The rover** shall be able to approach a switch on the control panel

SCRUM



TESTING

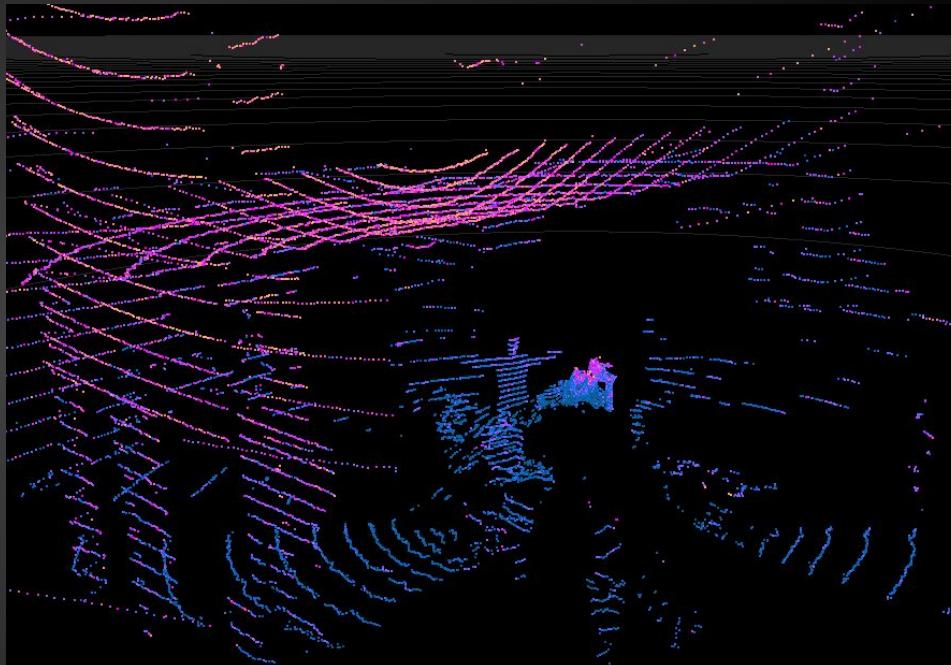


AUTONOMOUS NAVIGATION

LIDAR and Depth Camera



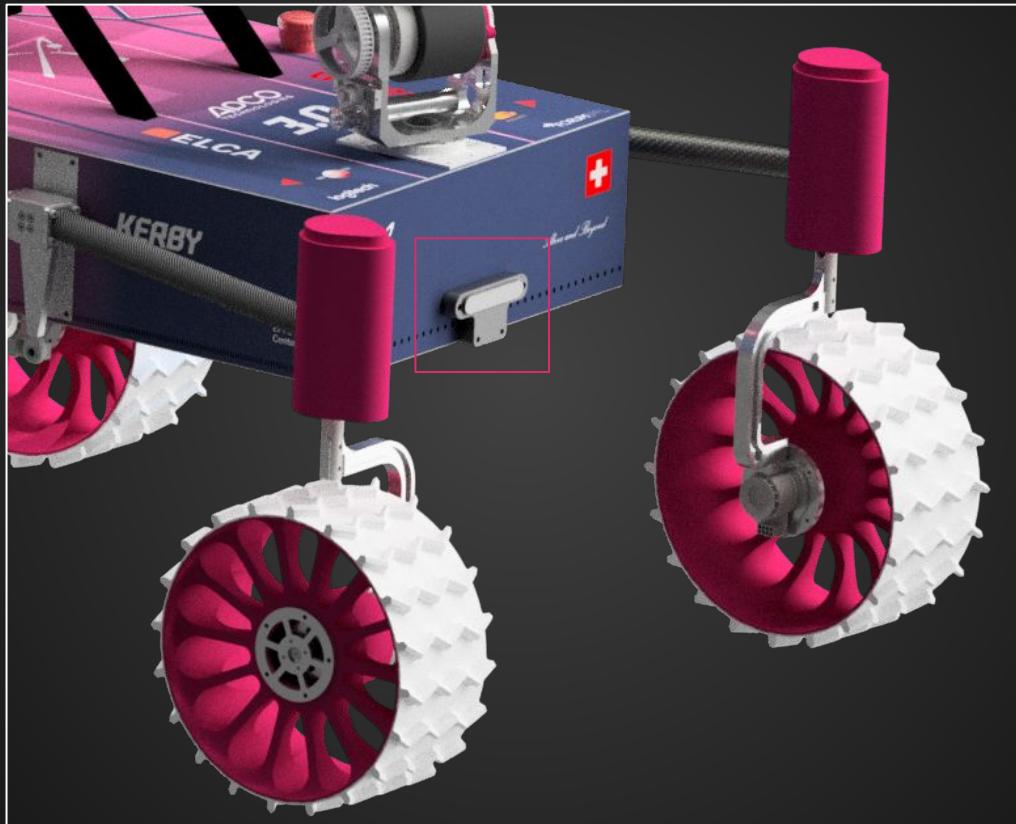
LIDAR detection



Almost...



Front Camera



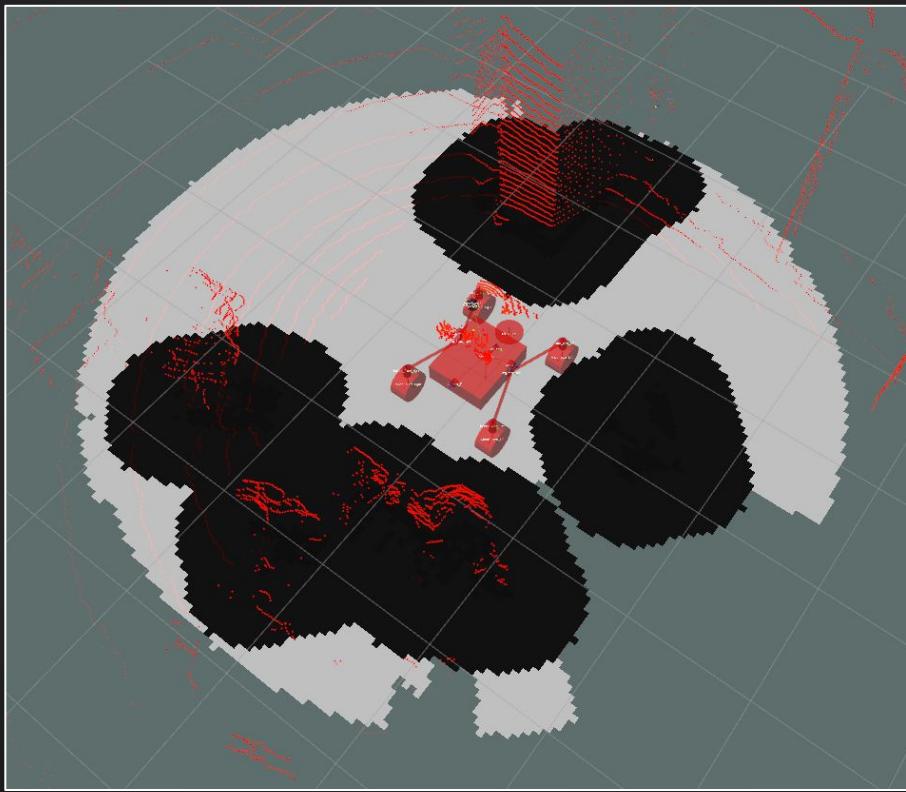
Front Obstacle Detection



Better!

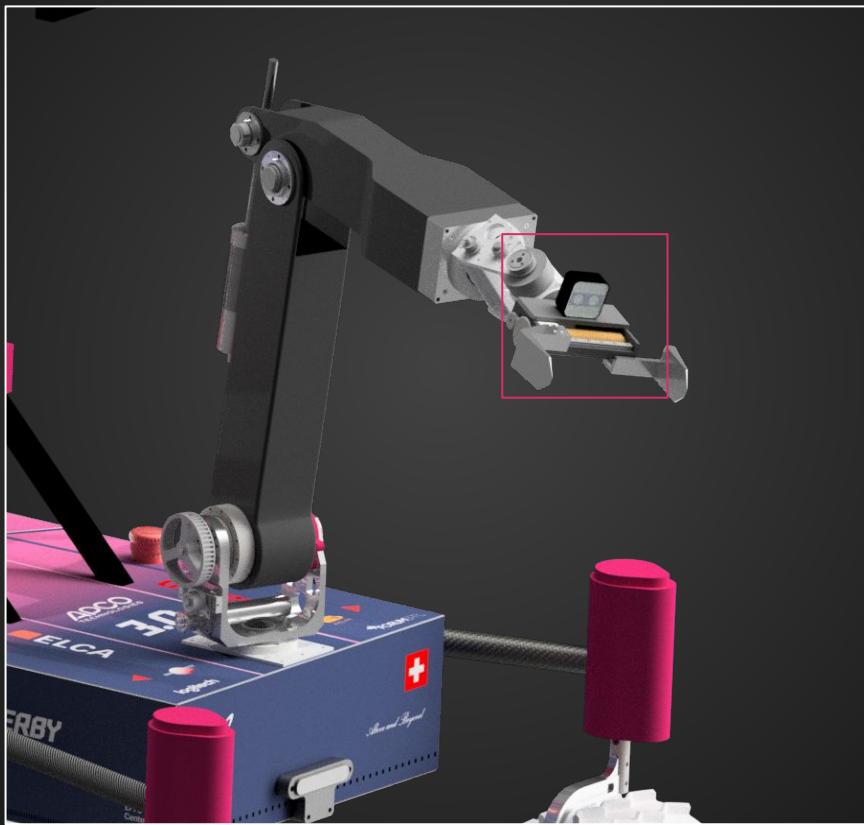


Costmap

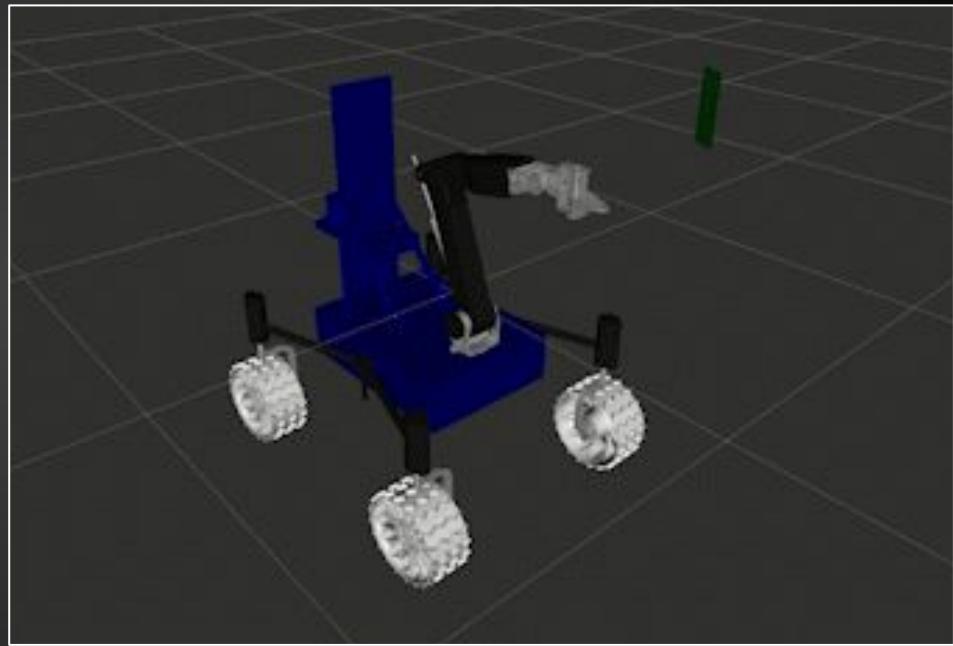


AUTONOMOUS
MAINTENANCE

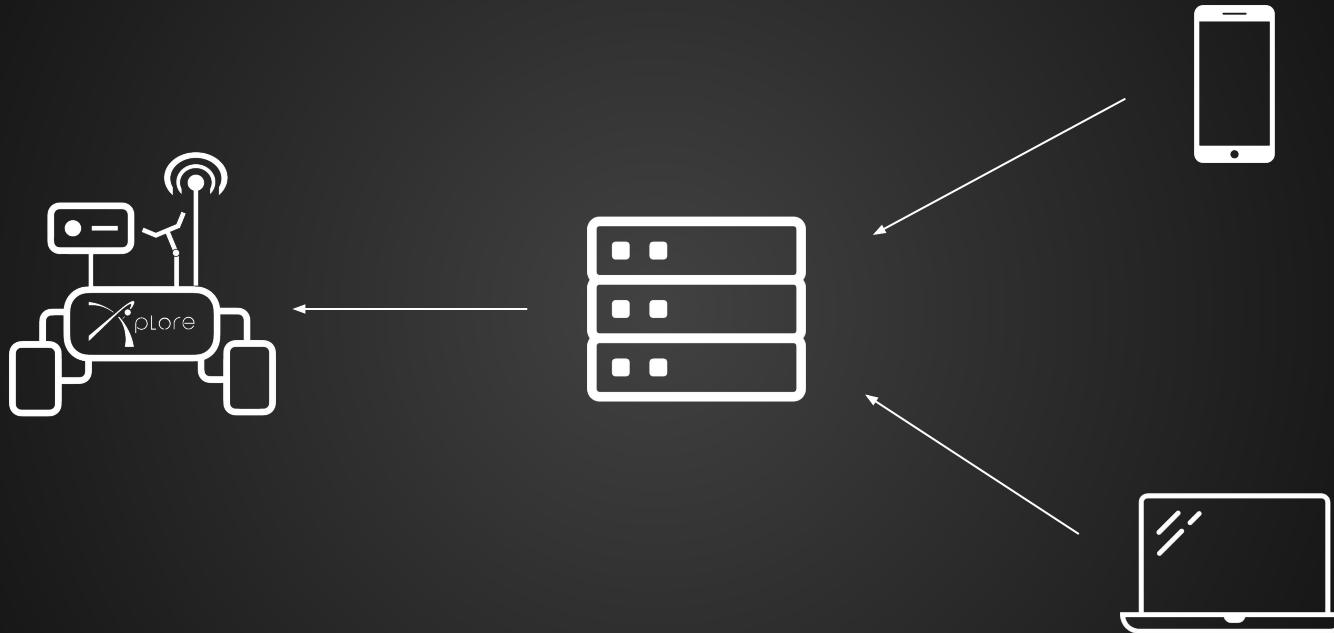
Gripper Camera



Autonomous Maintenance Task



One Node To Rule Them All





Start Rover



Documentation



Drive



Kerby



Navigation



Science



Handling Device



Information

100%



9 : 59
10



1
10



Kerby



Navigation

Autopilot
Semiautopilot
Manual



Science



Handling Device



Information

100%



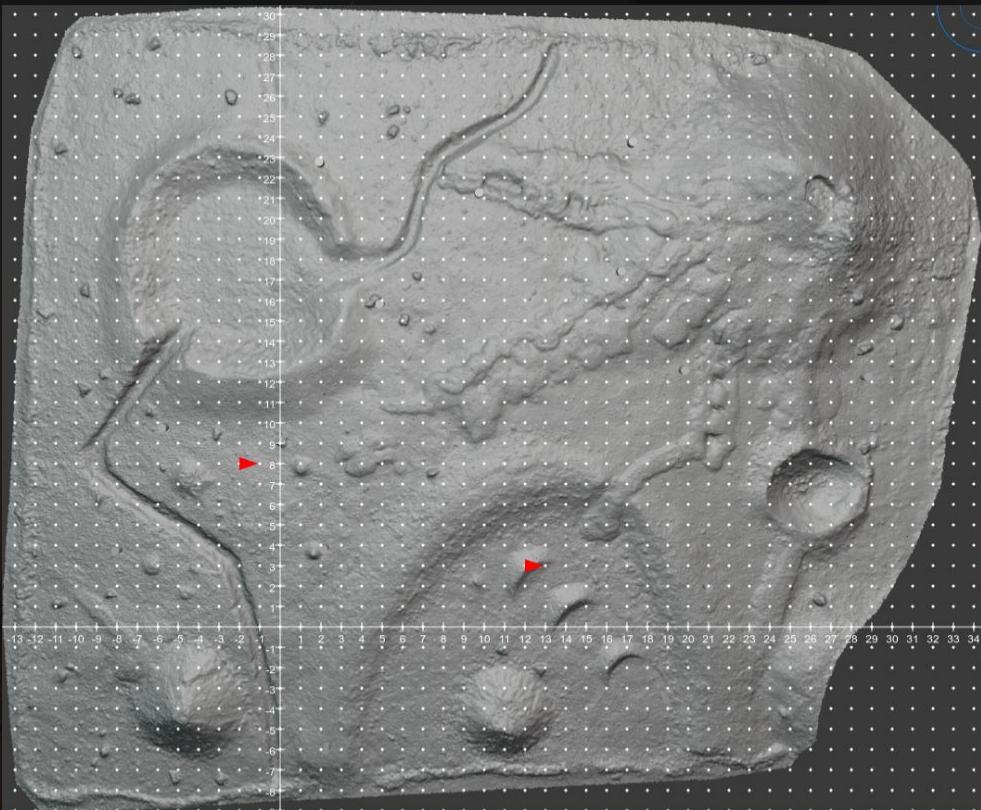
9 : 59
▶ ↺ 10

1

9 : 59



Autonomous Navigation



Target

Distance to goal: 15 m
Route left: 20 m
Estimated time: 07:00

Speed

Linear: 0.00 m/s
Angular: 0 rad/s

Wheels

Wheel FL: 0°
Wheel FR: 0°
Wheel RL: 0°
Wheel RR: 0°

Launch Abort
Wait Resume

Current Position

0, 0, 0°

X Y O

Add Goal

Reset Goals

Next Goals

(12, 3, 0°)

(-2, 8, 0°)



Kerby



Navigation



Science

Data
Drill



Handling Device



Information

100%



9 : 59
▶ ↺ 10

1



NPK sensor

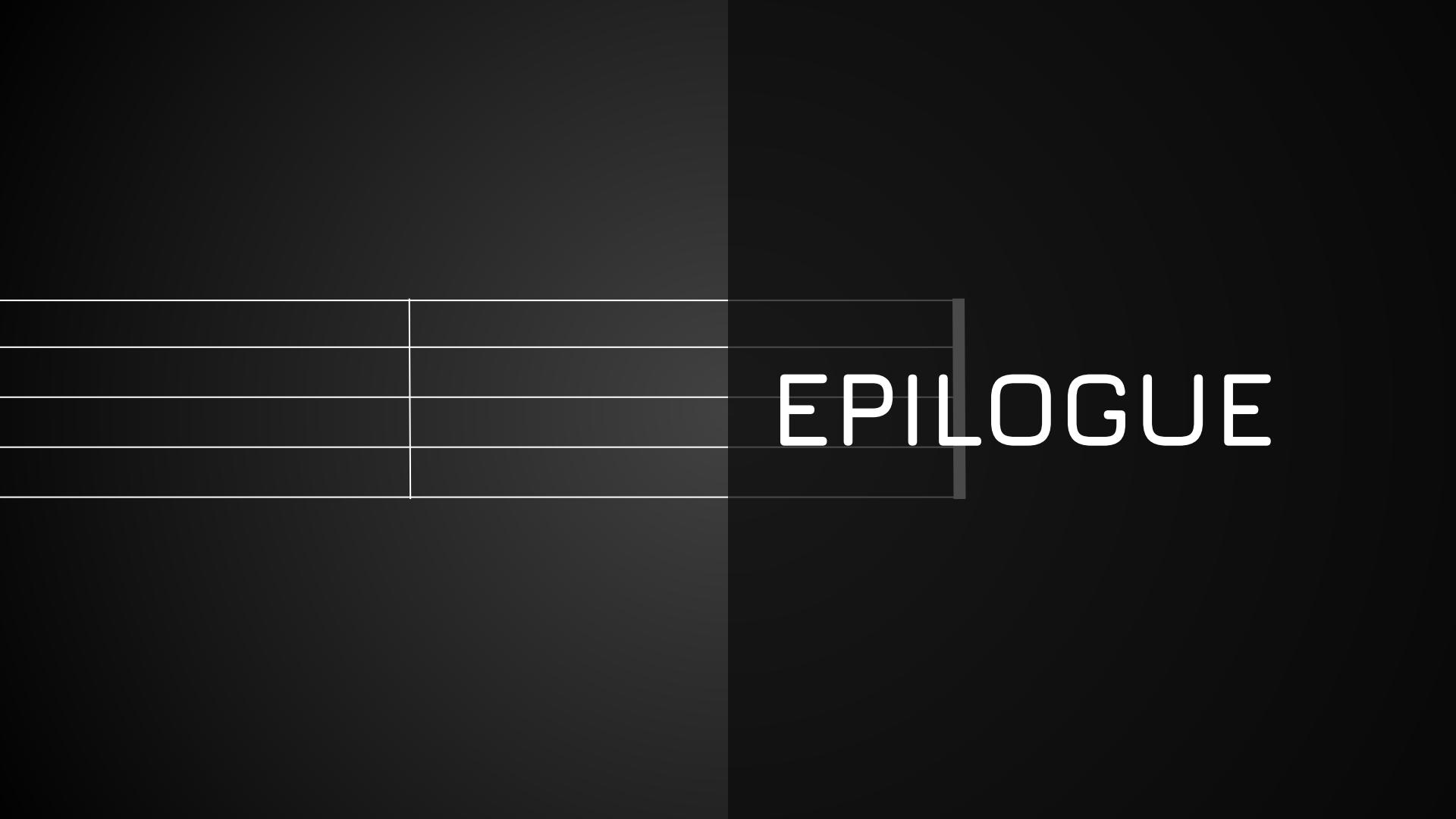
Element	Value
Phosphate	10
Azote	5.4
Potassium	12

4-in-1 sensor

Element	Value
Humidity	10
Temp	16
Elec	12
PH	6

Candidate 1	Candidate 2	Candidate 3	Candidate 4	Candidate 5
78%, Phosphate	77.8%, Materiau1	74%, Materiau2	73.9%, Materiau3	73.3%, Materiau4

Launch Abort
Wait Resume



EPILOGUE

AI for Good .

6-7 july

Geneva, Switzerland

European Rover Challenge 2023 .

15-17 september

Kielce, Poland

Xplore 2024

Project-based Learning

ERC-like competitions

XRC

Innovation

Bridge between
students and the
industry

Research

Step into the highest
level of development
and achievement in the
field of Robotics



EPFL

■ eSpace
EPFL Space
Center

maxon ■ **ELCA**

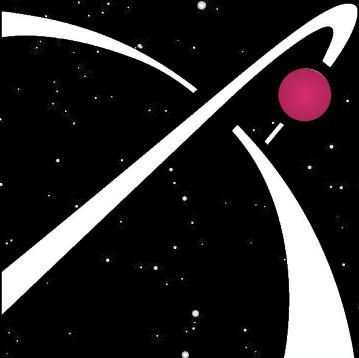
APCO
TECHNOLOGIES

logitech

■ **FORUM EPFL**

An orange cloud-like icon containing a pair of scissors.

A red circular logo with the words 'MARS SOCIETY SWITZERLAND' in white.



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projects