

# Fesl – Autonomous Outdoor Rover

Stereo  
Camera

Servo steering

GPS + IMU

Sick LIDAR

Industrial PC  
Nvidia GPU

# Computing Unit

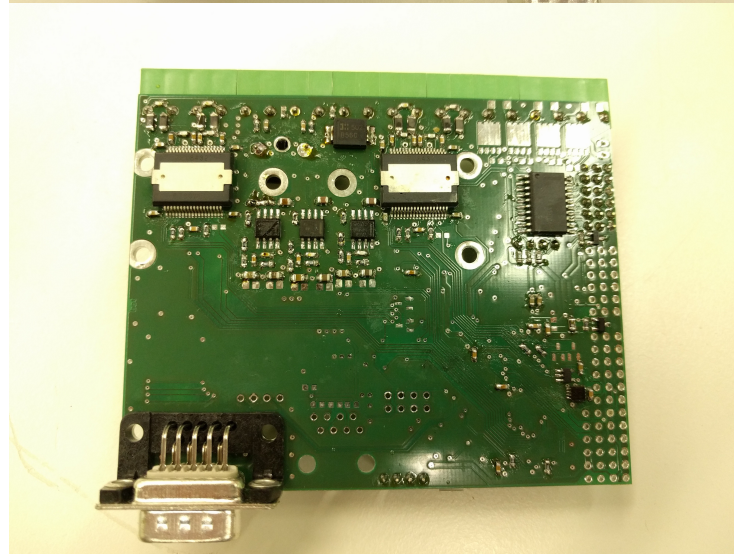
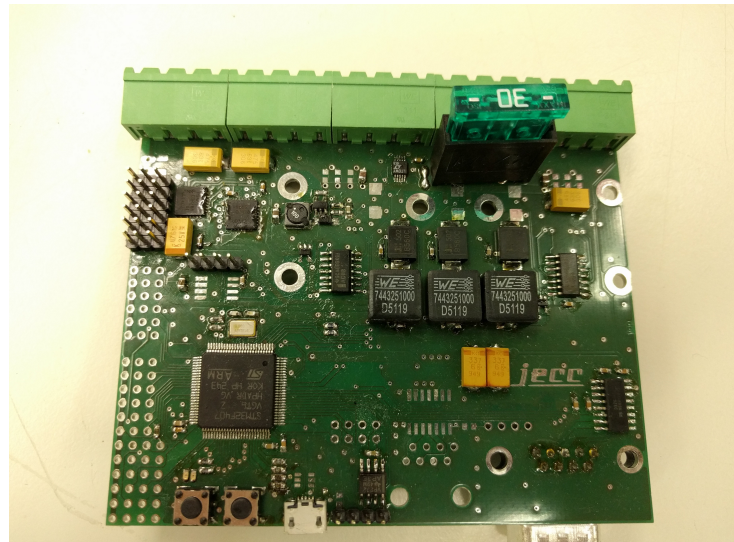
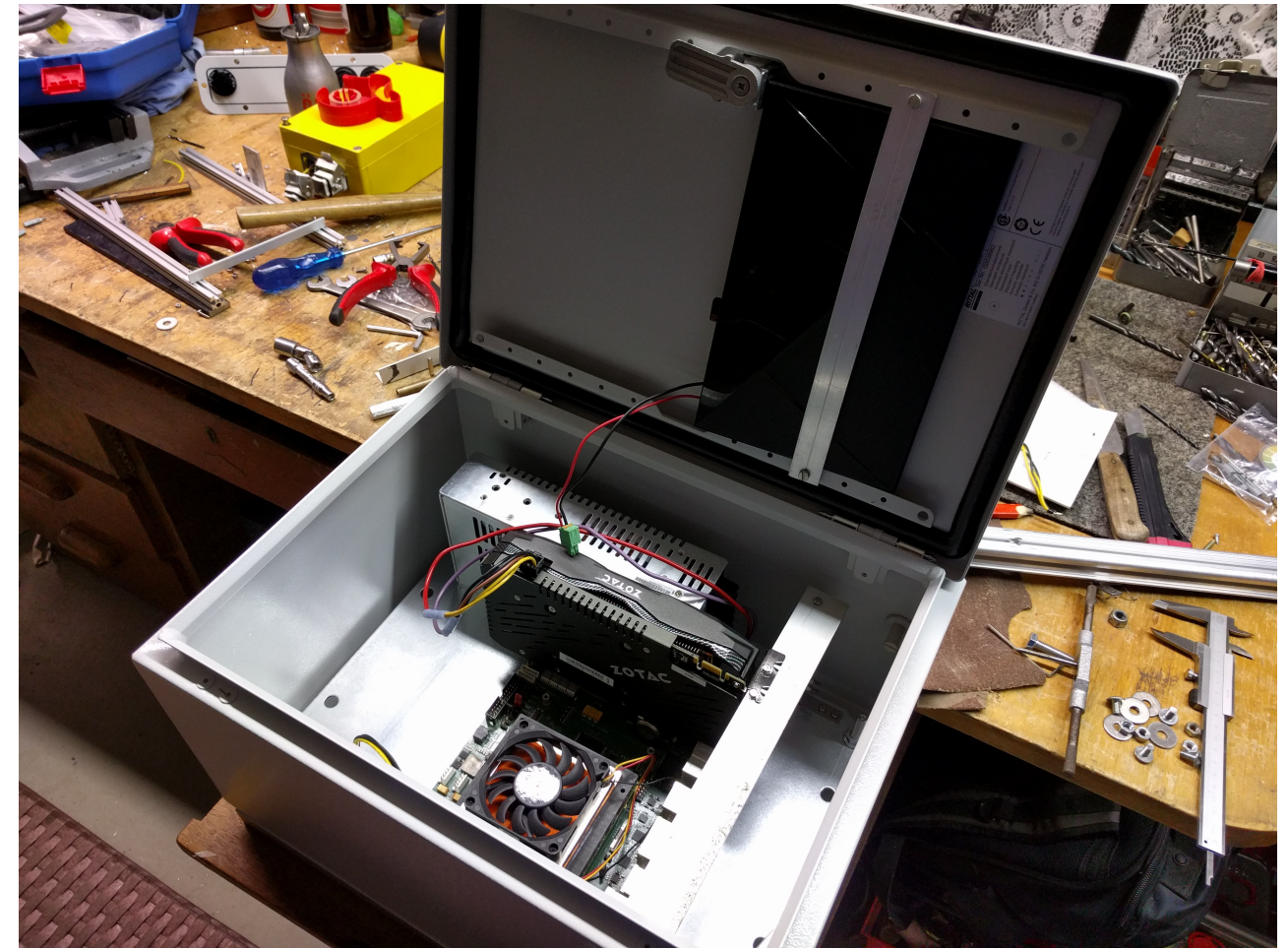
Industrial COM Express Module from Kontron

- 6<sup>th</sup> gen Core i7 CPU
- 8GB DDR4 RAM
- 64GB SSD

Nvidia GTX 960 GPU

- 4GB Videomemory
- 2.7 Tflop/s

200W DC/DC Converter



## Motor and Servo controller

Custom PCB

STM32 F4 Microcontroller

Two 14Amp Motordrivers up to 52V

RS232, RS485, CAN, USB

Killswitch

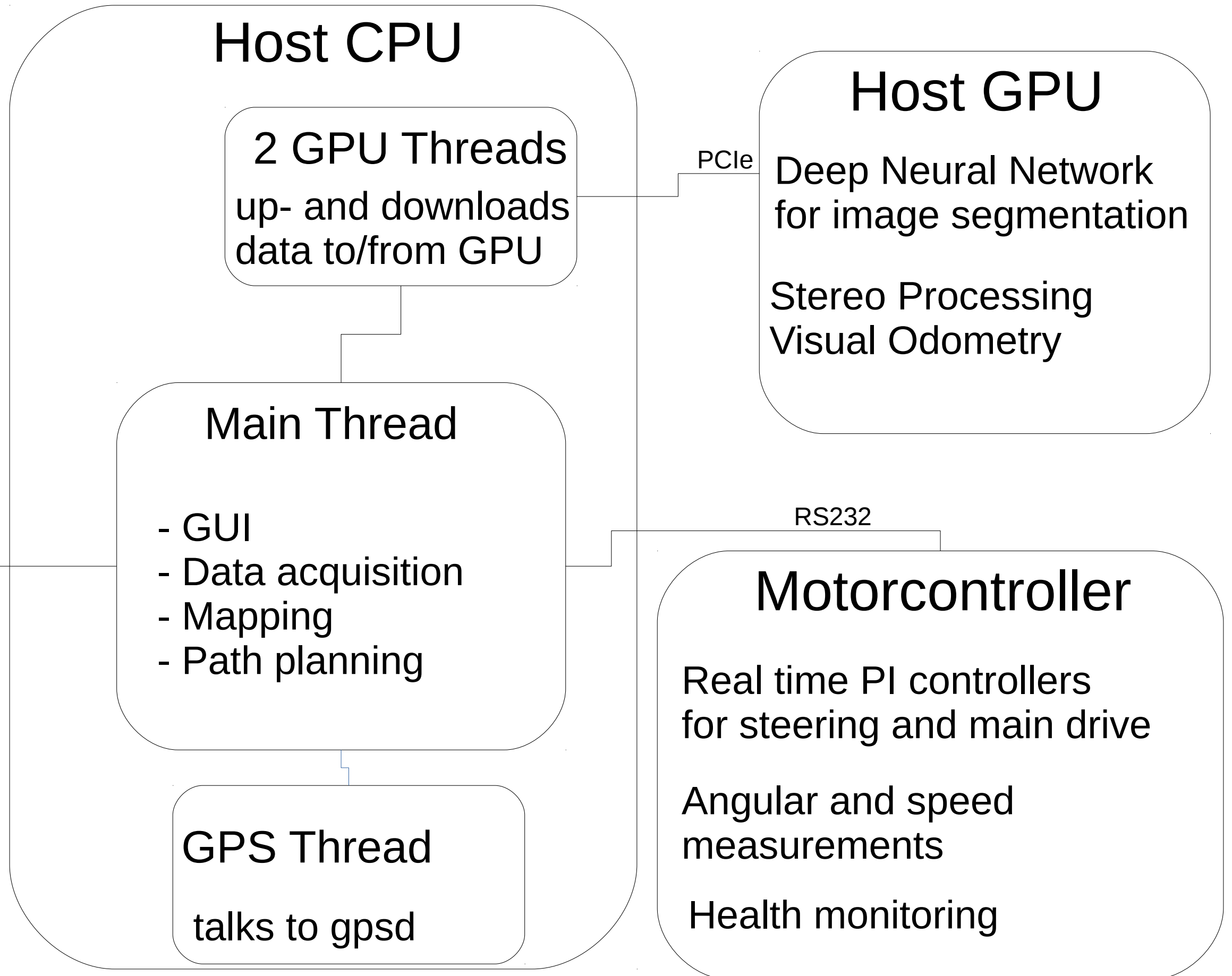
Safety functions

Current and voltage monitoring

# Software Architecture

OS:  
Ubuntu 14.04

Frameworks:  
OpenCV  
Caffe  
Qt  
No ROS! ;-)



Camera  
Laserscanner  
IMU

USB

## Host CPU

2 GPU Threads  
up- and downloads  
data to/from GPU

## Main Thread

- GUI
- Data acquisition
- Mapping
- Path planning

GPS Thread  
talks to gpsd

## Host GPU

Deep Neural Network  
for image segmentation

Stereo Processing  
Visual Odometry

PCIe

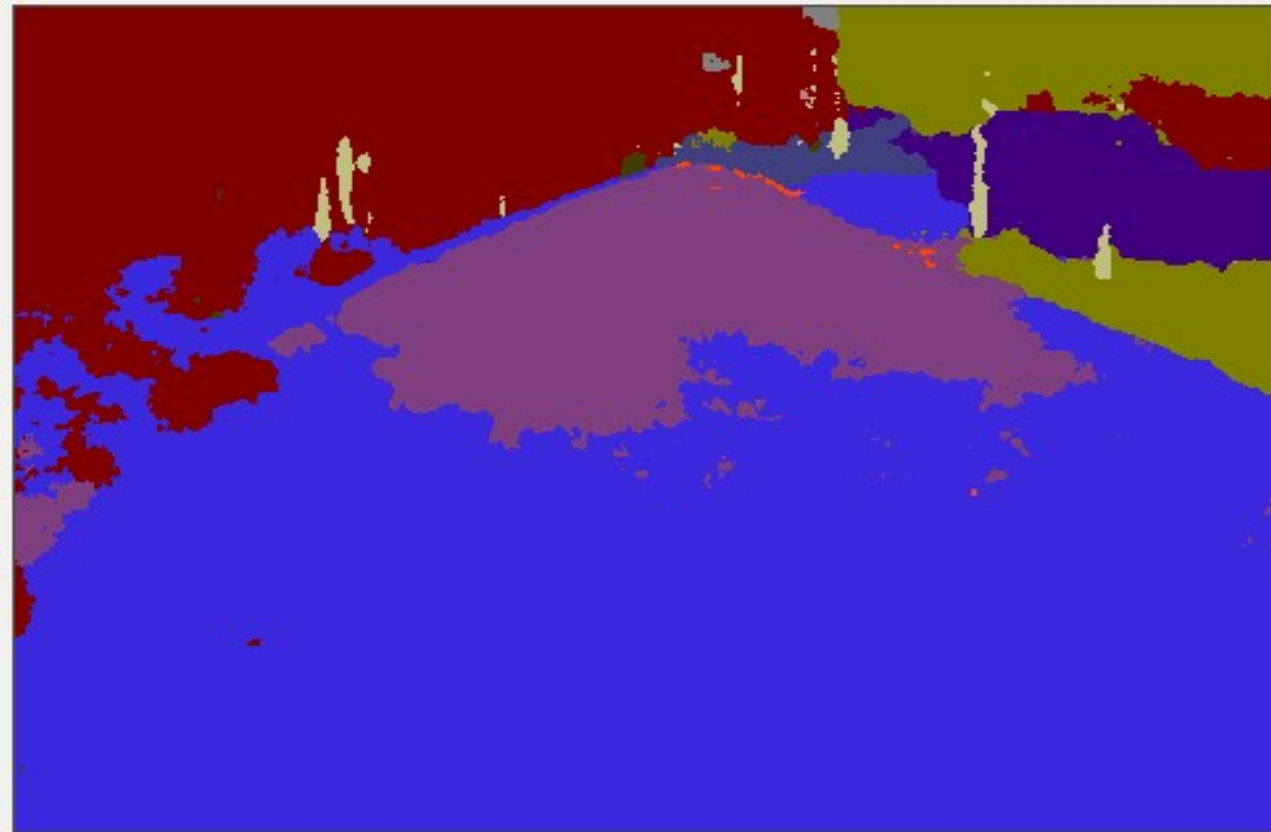
RS232

## Motorcontroller

Real time PI controllers  
for steering and main drive

Angular and speed  
measurements

Health monitoring



mask nnTime:



Open

Sys: 0%

Gyr: 100%

Acc: 33%

Mag: 0%

600

Competition Mode  
MOTOR ON  
way free

**Opmode**

stop

manual

autonomous

semi-auto

sick navigation

enable Neuralnet 30000

Lat: 48.82961983 Lon: 12.955291

3D FIX

GPS available

act:

error:

pwmout:

offset:

set angle: 0

D-Weight: 0.0035

9 m

TextLabel

Reset Tracking

STATE: 4 | TRACKING\_GOOD

tx: -1.72772

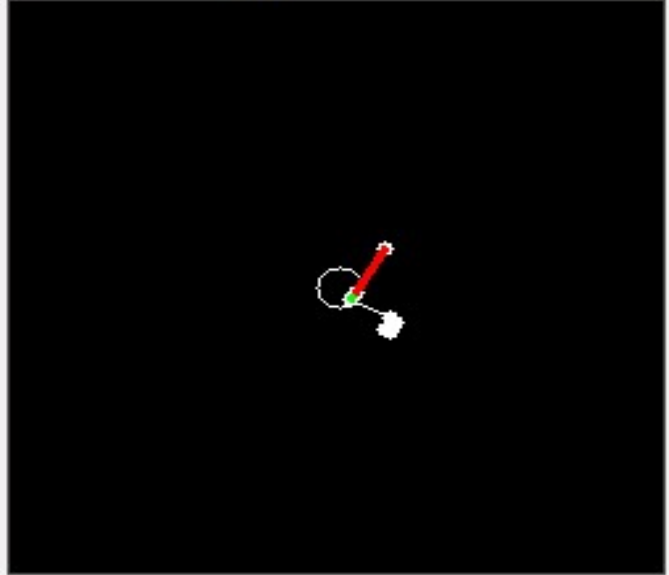
ty: 18.5297

tz: 10.0773

Pitch: -50.7494

Yaw: -13.5647

Roll: -0.96505



0x15fb50 0x5f330f

0x15fb3a 0x5f331b

0x15fb3d 0x5f3320

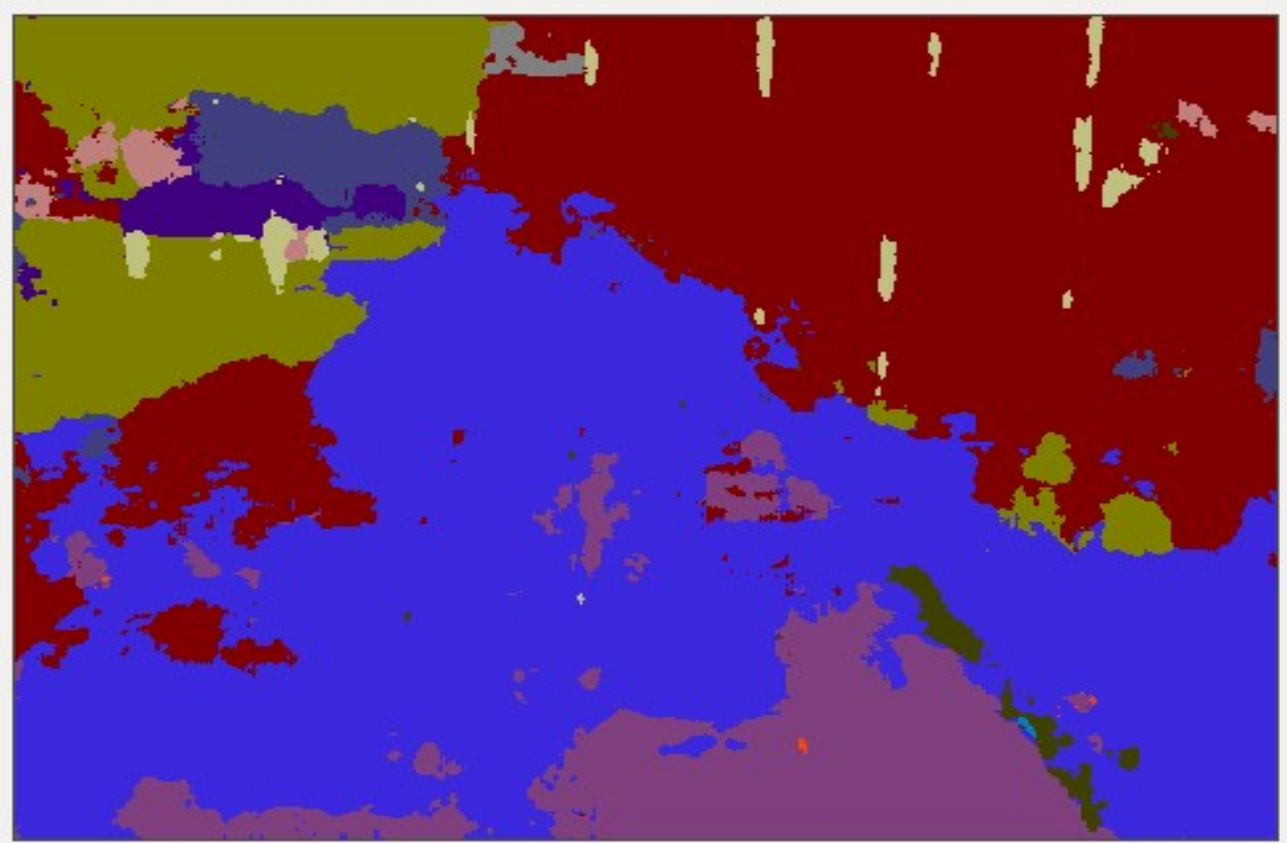
0x15fb4d 0x5f333d

1.367

4.738

45m | 45°

sick on



mask nnTime:



Sys: 0%

Gyr: 100%

Acc: 33%

Mag: 0%



Competition Mode

MOTOR ON

way free

**Opmode**

- stop
- manual
- autonomous
- semi-auto

```
STATE: 4 | TRACKING_GOOD
tx: 4.04442
ty: 13.9647
tz: 6.10743
Pitch: -35.9023
Yaw: 88.7762
Roll: -14.8049
```

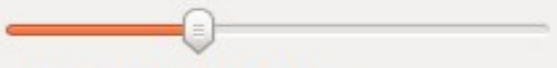
- sick navigation
- enable Neuralnet 30000

Lat: 48.829534 Lon: 12.95541167

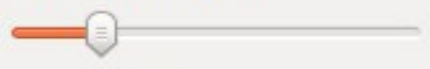
3D FIX

GPS available

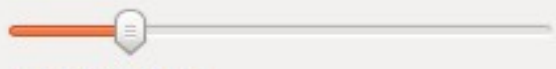
act:  
error:  
pwmout:  
offset:  
set angle: 0



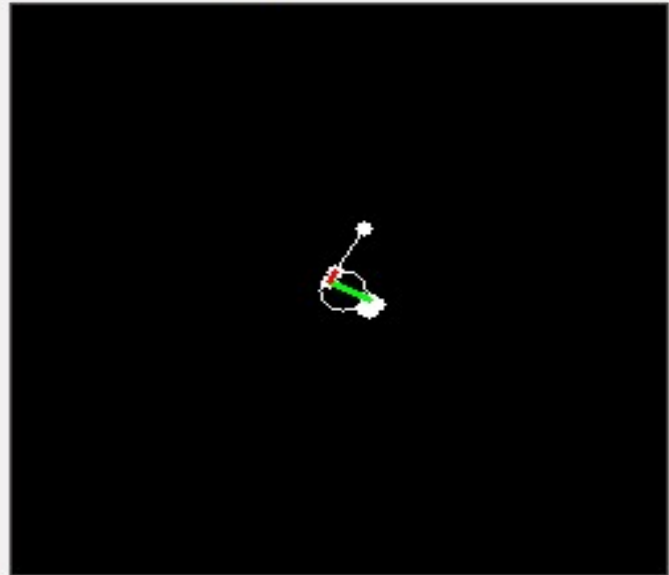
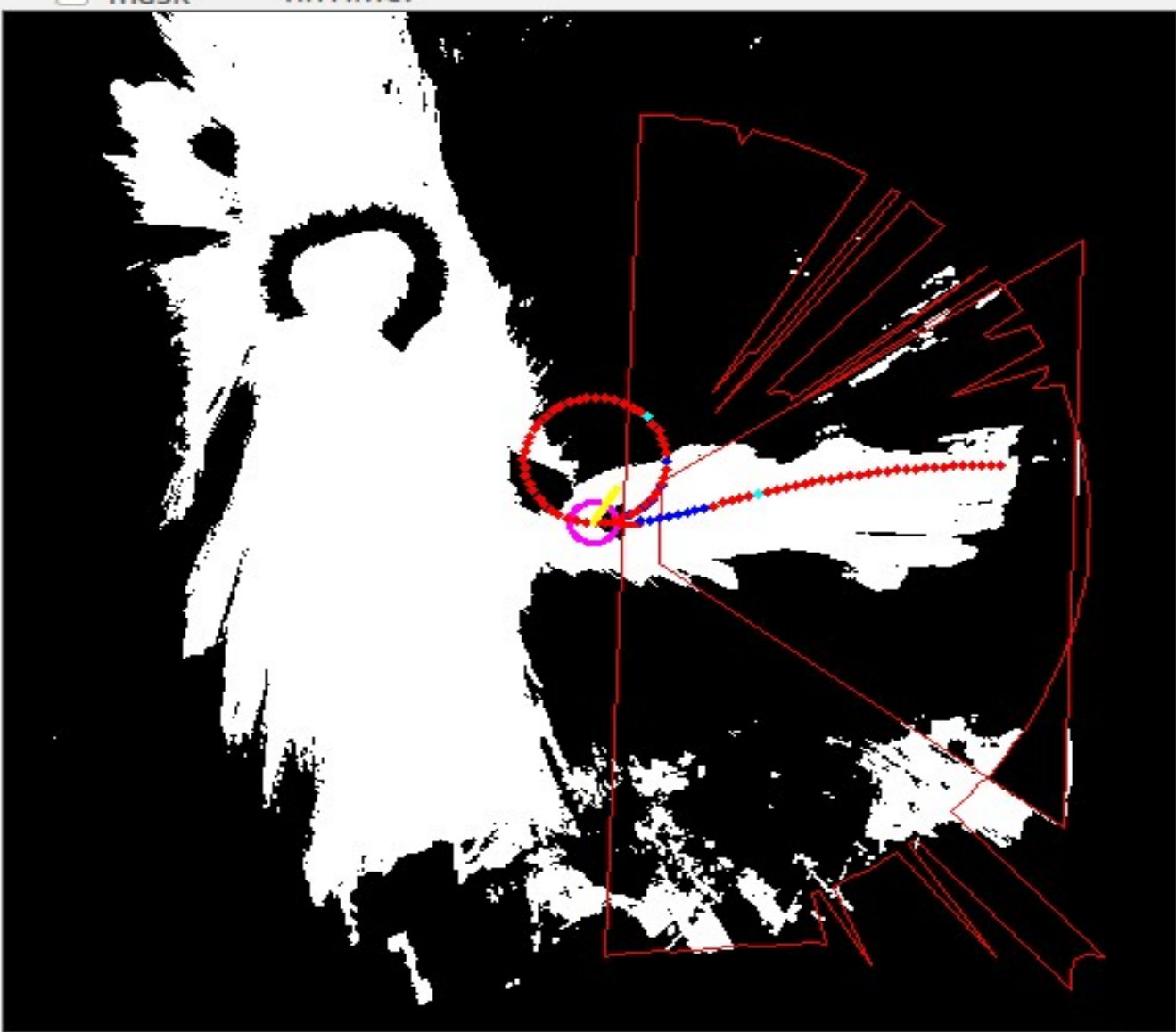
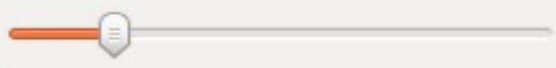
D-Weight: 0.0035



9 m



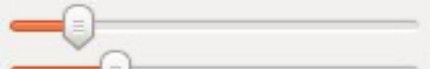
TextLabel



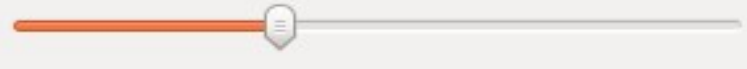
1.367

4.738

```
0x15fb50 0x5f330f
0x15fb3a 0x5f331b
0x15fb3d 0x5f3320
0x15fb4d 0x5f333d
```



45m | 45°



# Robotour 2016 – what failed?

1. Round – Raindrops on LIDAR
2. Round – Battery drain :-(
3. Round – Water in IMU
4. Round – Compass Offset