Autonomous boats

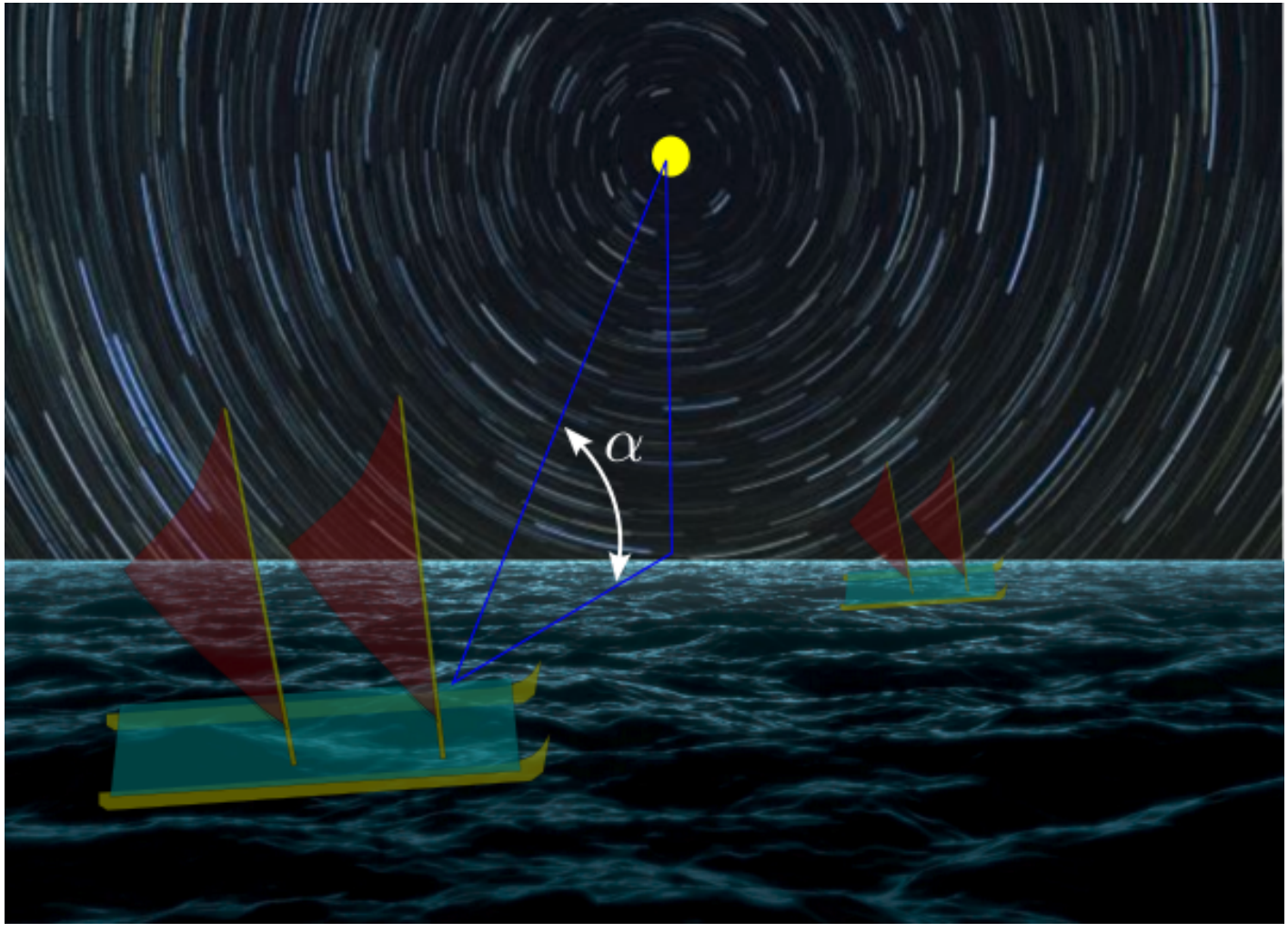
L. Jaulin, October 2026, Monday 19, Guerlédan

Site: https://webperso.ensta.fr/jaulin/best26.html



1. Sensors


N
NE
E
SE
S
SW
W
NW
30
60
90
120
150
180
210
240
270
300
330
360



Latitude



Subtended angle



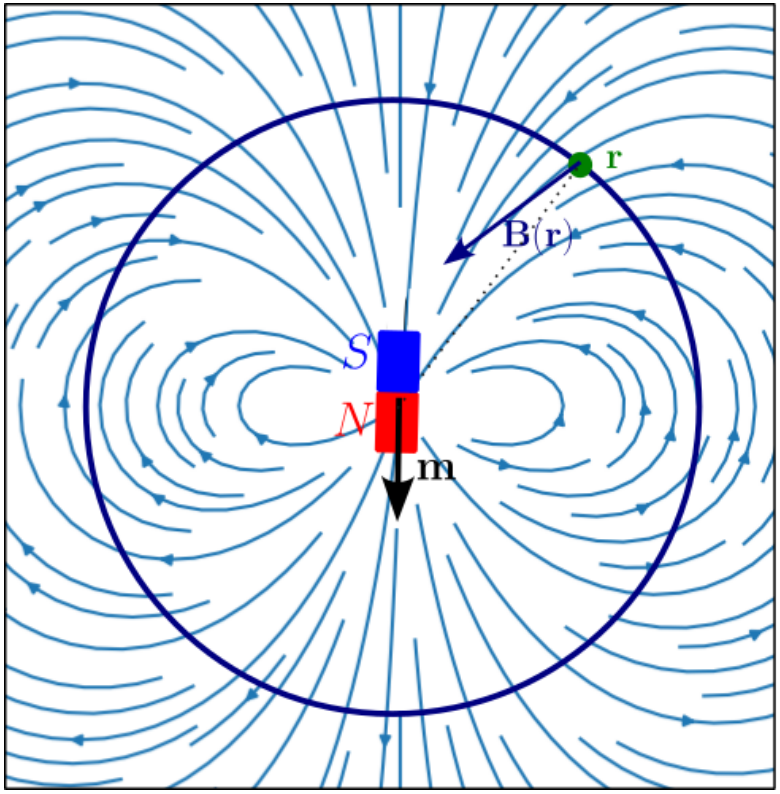
Sextant

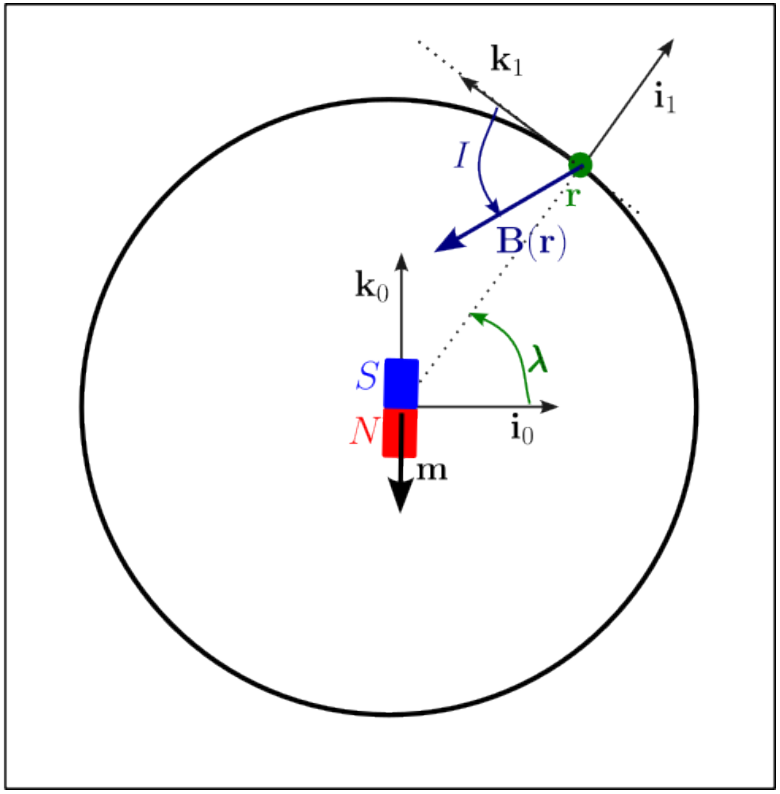


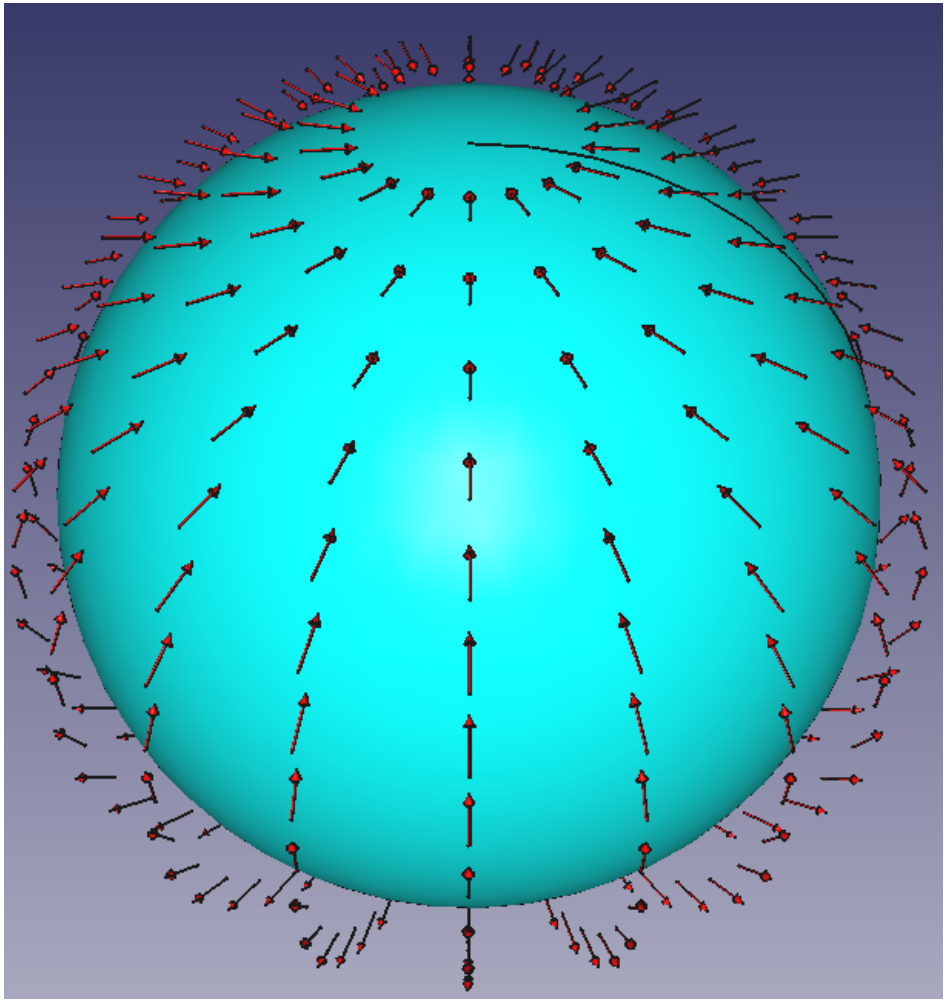
Theodolite



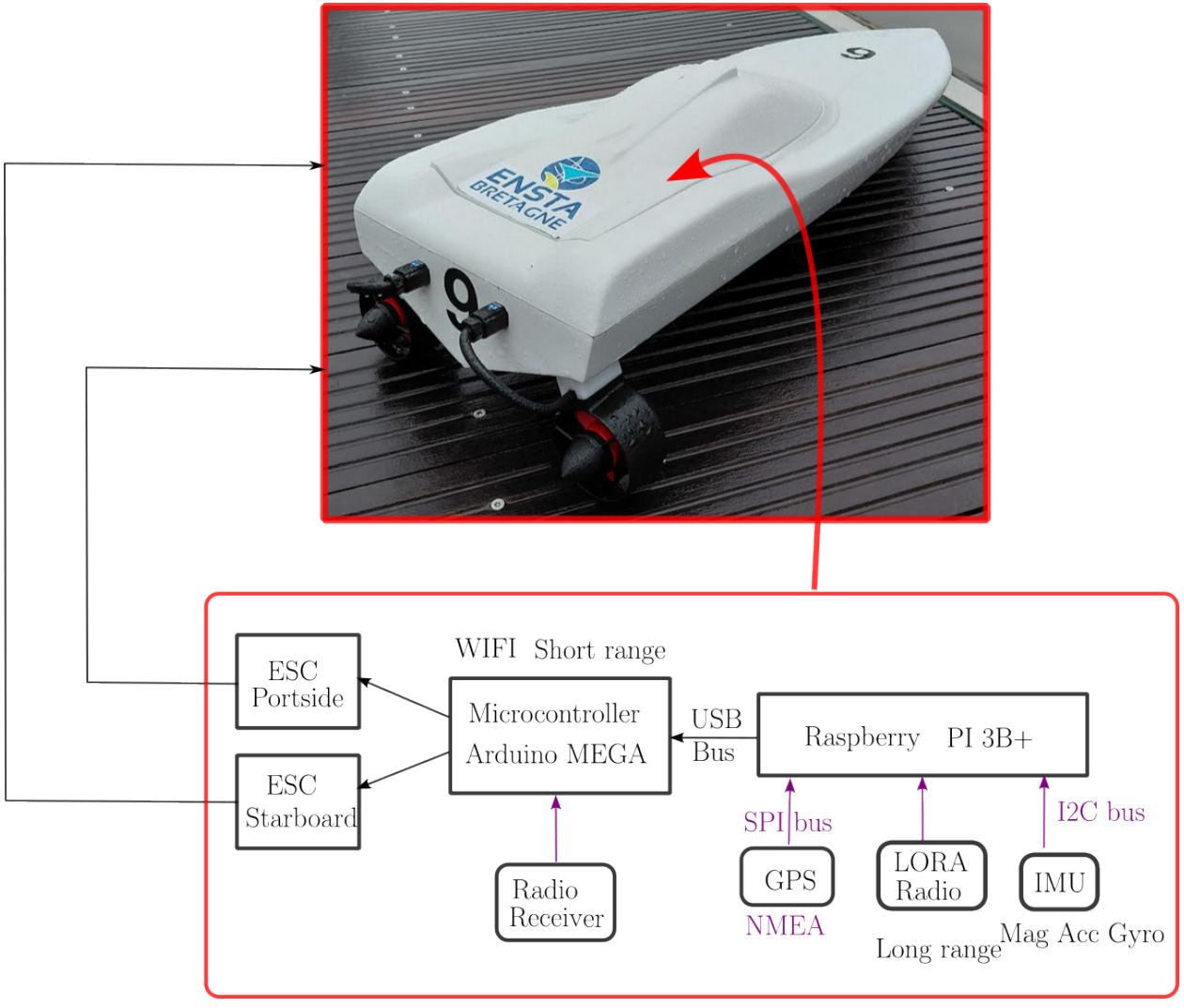
Camera

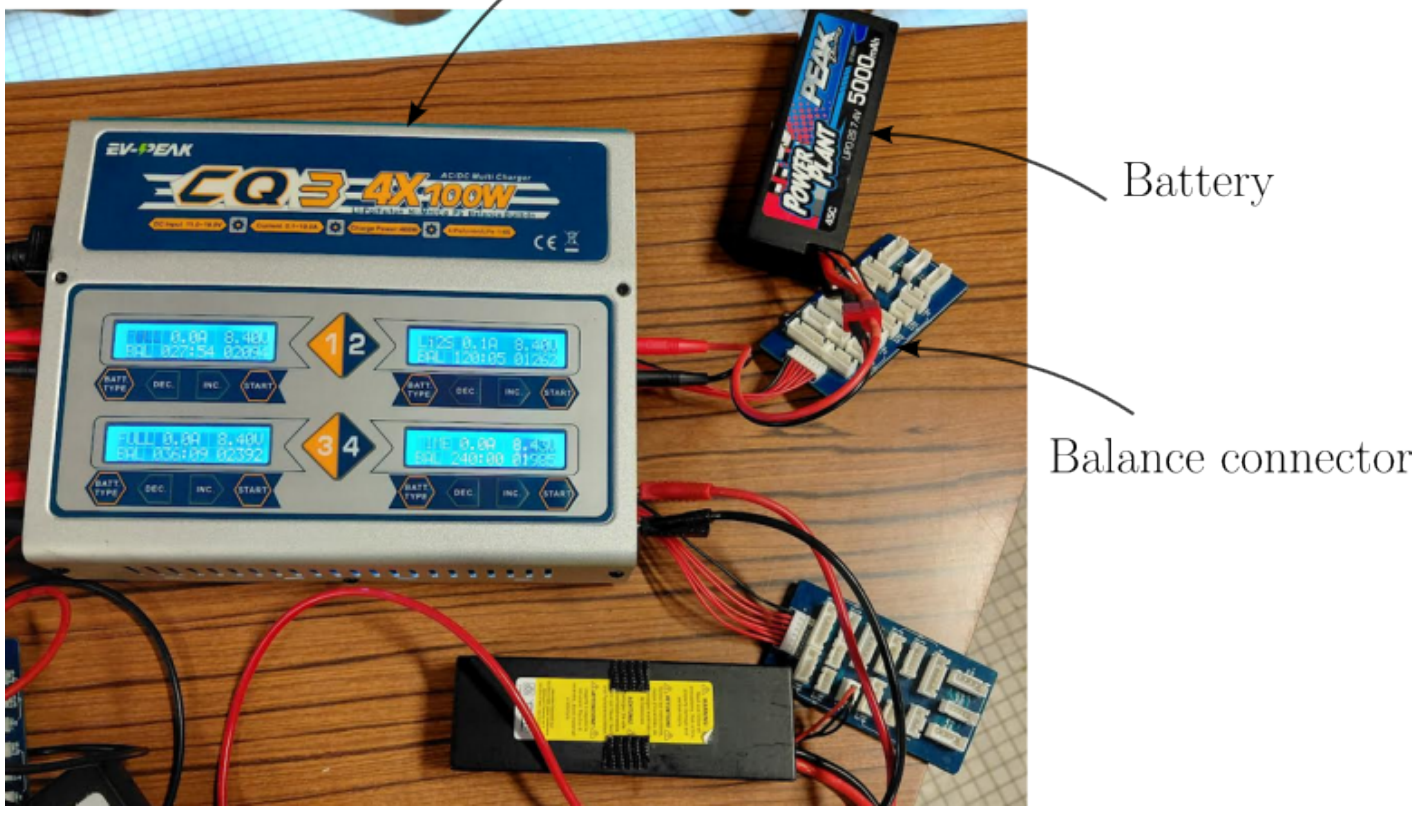

r
B(r)
S
N
m


k1
i1
I
r
B(r)
k0
λ
S
N
i0
m



2. DD-Boats

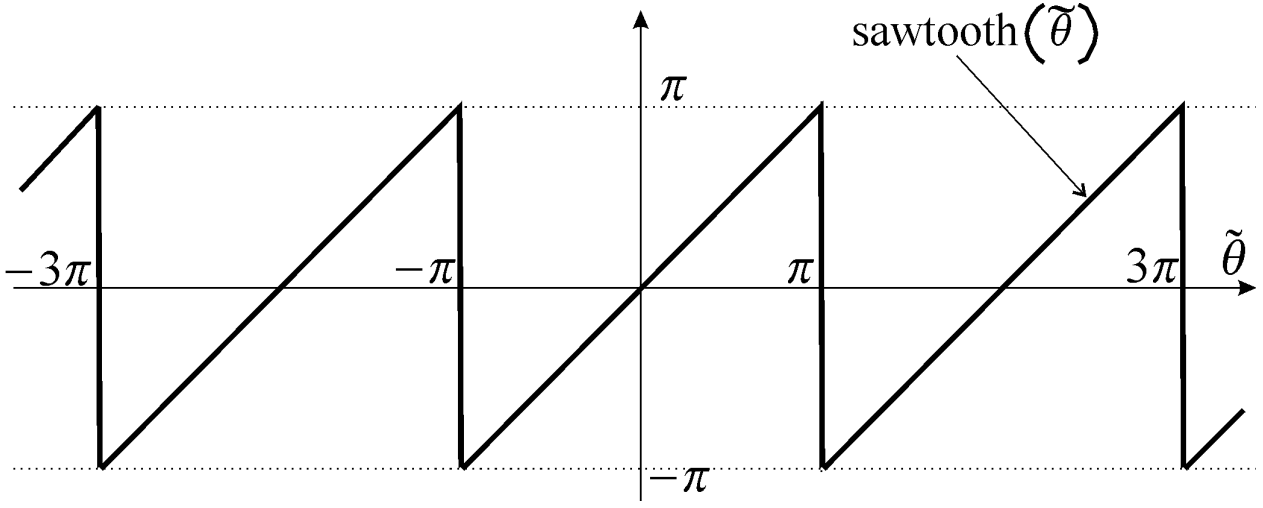

ENSTA BRETAGNE
ESC Portside
ESC Starboard
WIFI Short range
Microcontroller Arduino MEGA
USB Bus
Raspberry PI 3B+
Radio Receiver
SPI bus
GPS
NMEA
LORA Radio
Long range
I2C bus
IMU
Mag Acc Gyro


Charger
Battery
Balance connector
EV-PEAK
CQ3-4X100W
PEAK
POWER PLANT
5000

3. Heading control

The sawtooth function is the identity in $[-\pi, \pi]$ and 2π-periodic:

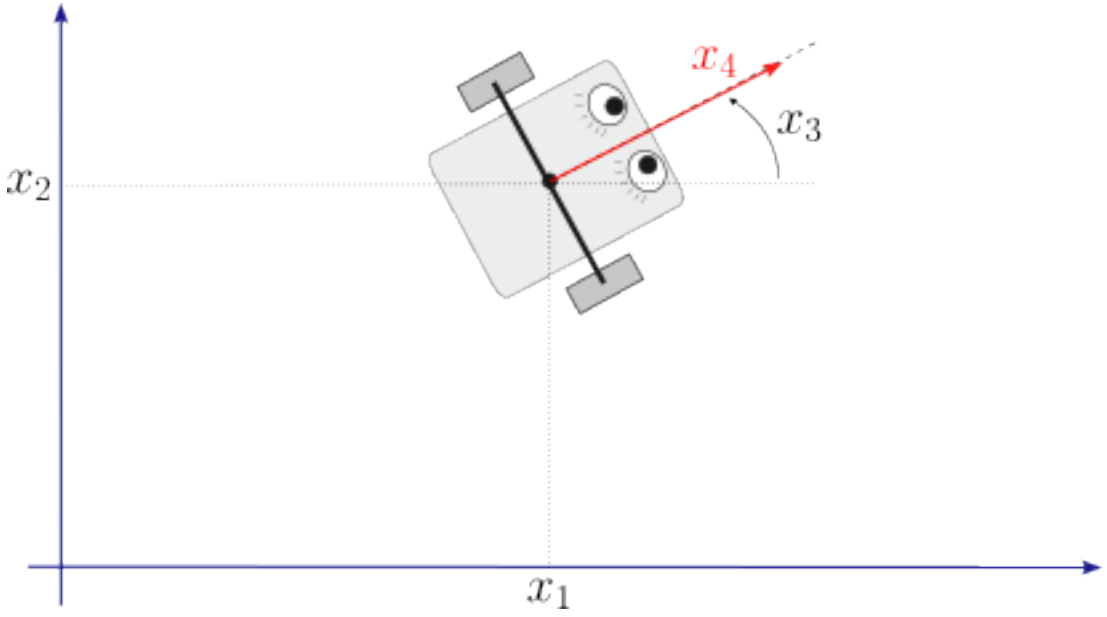
$$\text{sawtooth}(\widetilde{\theta}) = 2\text{atan}\left(\tan\frac{\widetilde{\theta}}{2}\right) = \text{mod}(\widetilde{\theta} + \pi, 2\pi) - \pi$$



A proportional controller is :

$$\begin{aligned} e &= \text{sawtooth}\left(\theta_d - \theta\right) \\ u_1 &= 10 + e \\ u_2 &= 10 - e \end{aligned}$$

4. Simulation


x_4
x_3
x_2
x_1