universite PARIS-SACLAY

C3 – Intelligence Artificielle pour la Robotique

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Organisation

Séances :

12 Janvier	Robotique mobile et Webots (BV)
19 Janvier	Localisation (BV)
26 Janvier	Télémétrie laser (BV)
2 Février	Navigation réflective (BV)

16 Février, 30 Février, 8 Mars – Sergio Rodriguez (IA)

Format :

1h de présentation / cours

2h30 de TP sur simulateur Webots en binôme

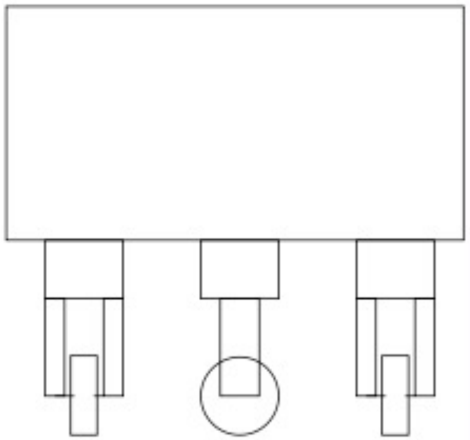
Évaluation (pour ma partie) :

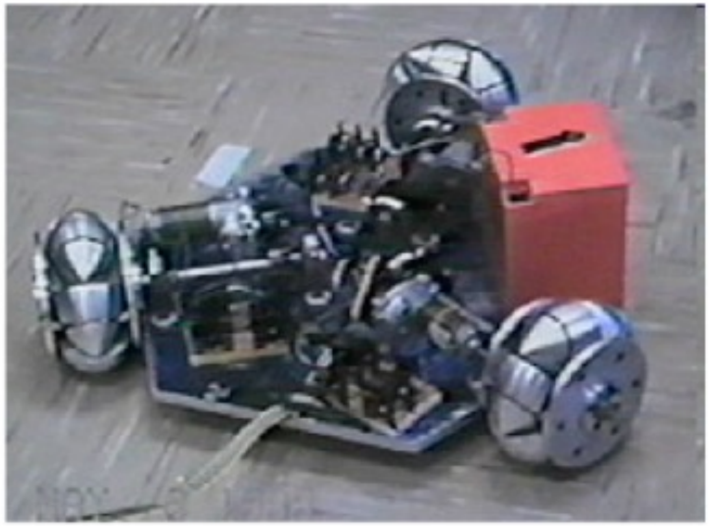
3 comptes rendus (à partir du second TP) à rendre avant le vendredi suivant.

Etudiants inscrits

BERTHOUMIEUX Simon
CHASSIN Victor
CHOUKRI Yassine
DERBAL Iyadh
DJELLALIL Yacine
DO NASCIMENTO SANTOS Alaf
HOLLENSTEIN Guillaume
KHORSI Mohamed Merzak
LI Ziyu
x MASSCHELIER Paul-Marie
OMARINI Thomas
TAFFIN Gabriel
TRUONG Alexandre

Plateforme Holonome





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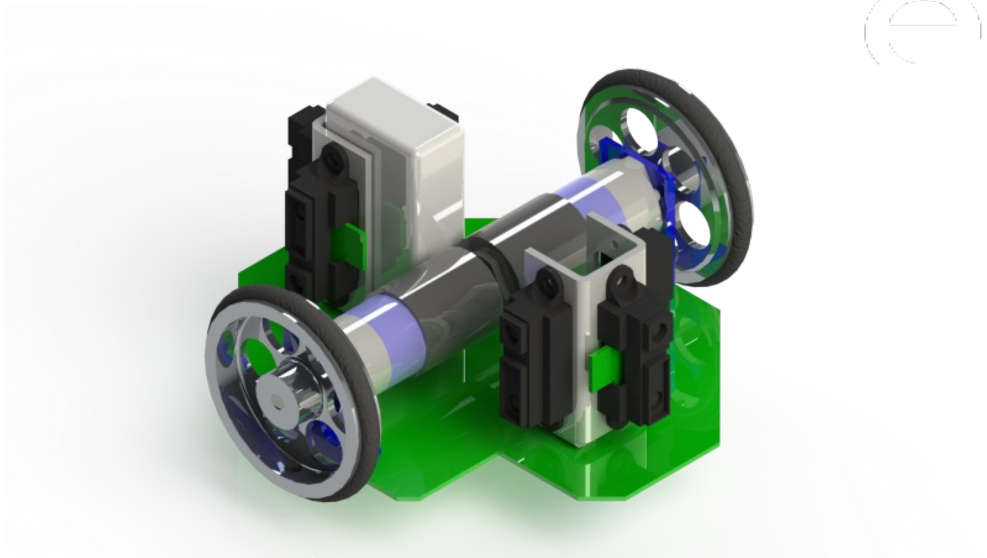
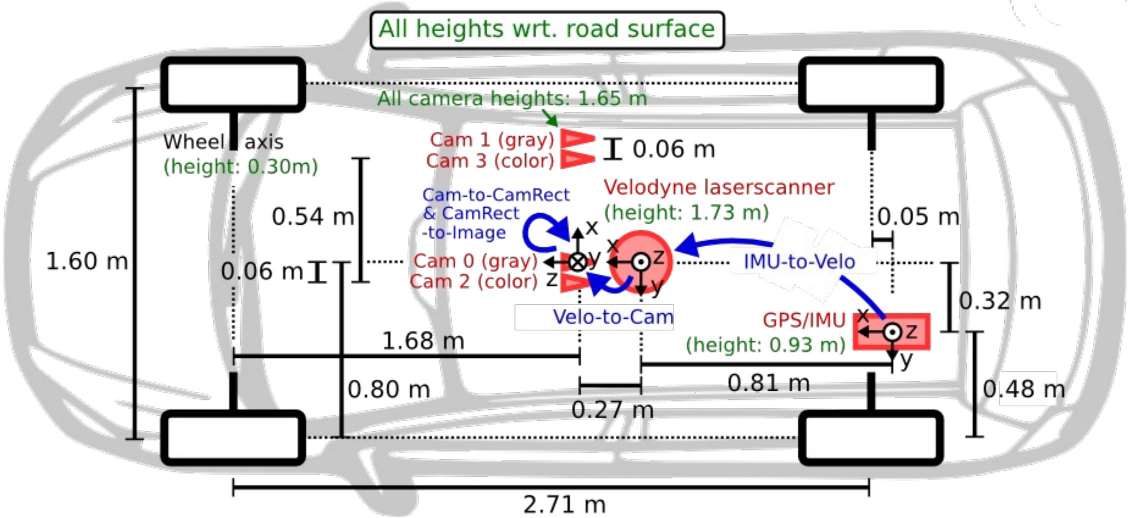
Plateforme à pattes



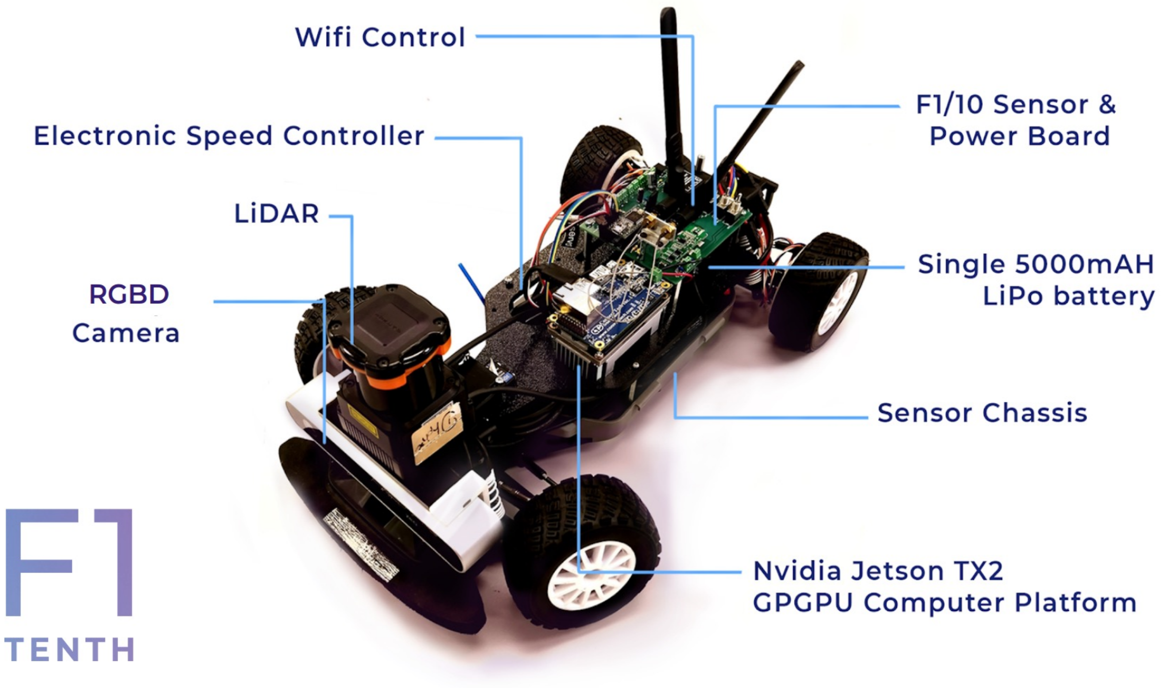
Robot différentiel



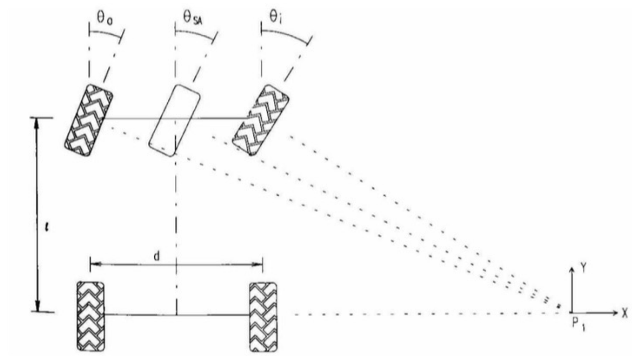
Robotique mobile



Robotique mobile

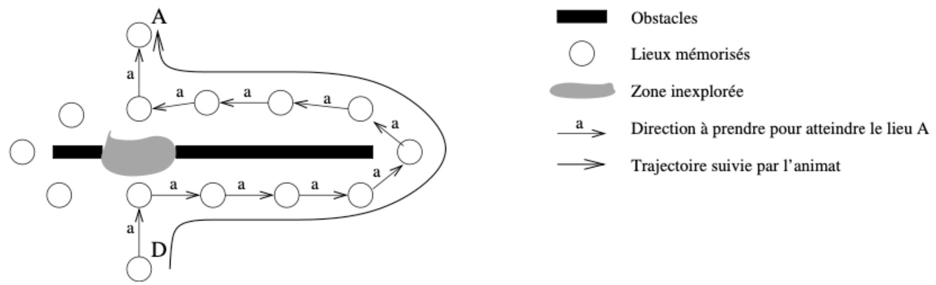


F1 TENTH

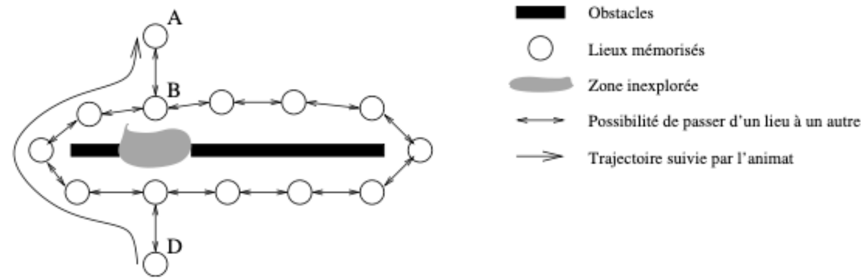


Les stratégies de navigation

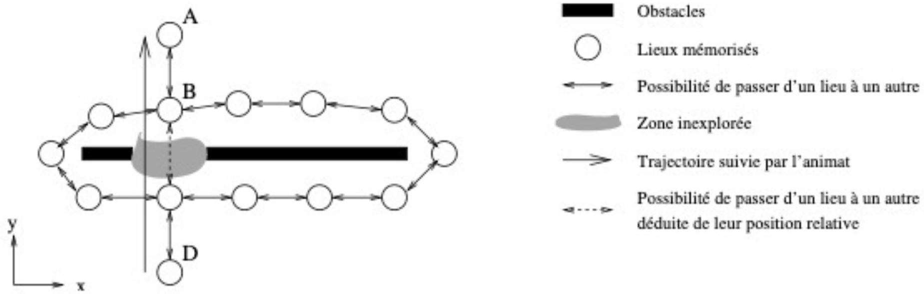
1 - Approche d'un objet
2 - Guidage
3 - Action associée à un lieu



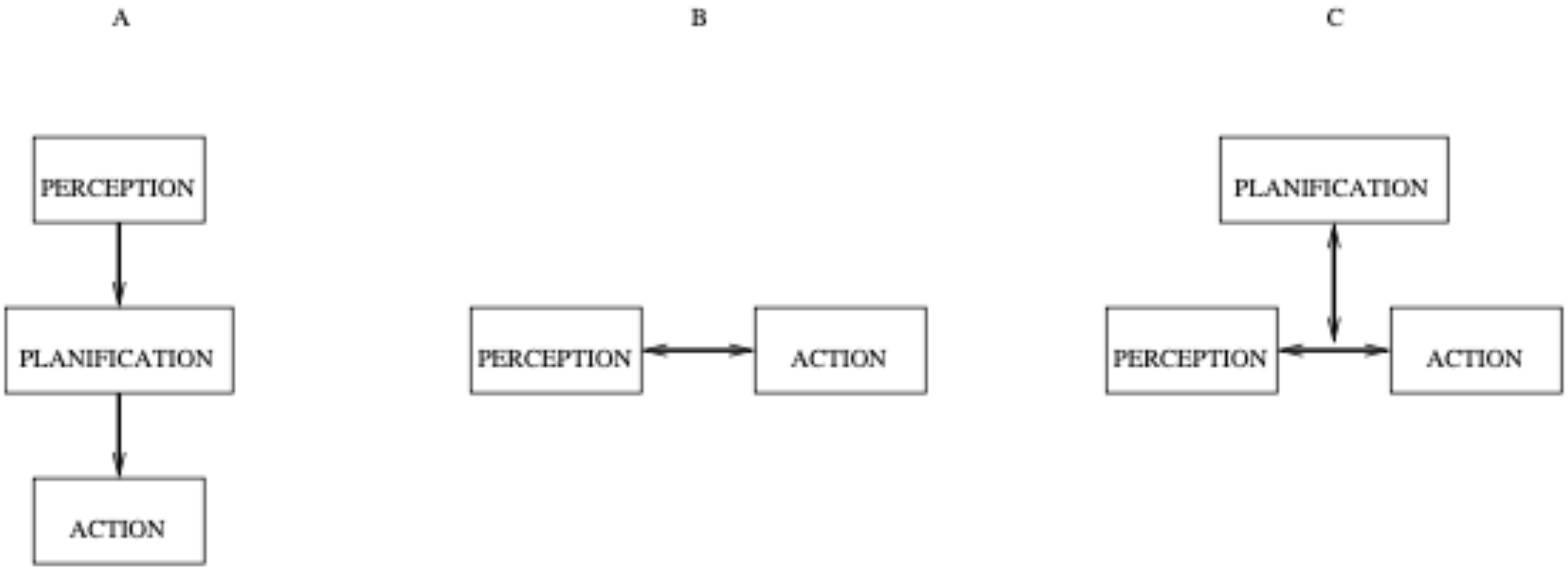
4 - Navigation topologique



5- Navigation métrique



Les architectures de contrôle



Robotique mobile

Algorithmes de base d'un véhicule autonome :

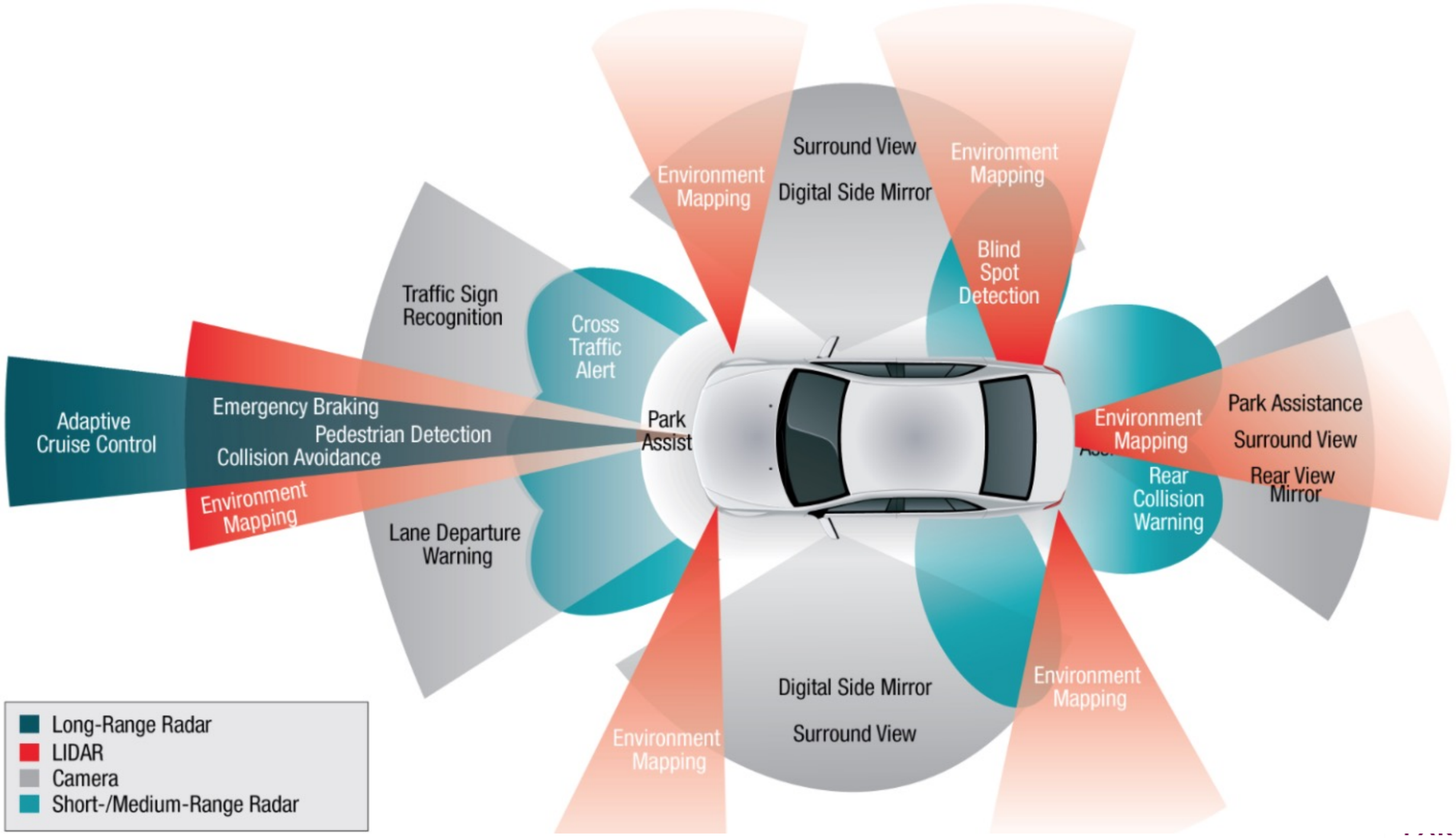
- Planification

- Localisation

- Perception de l'environnement

→ Regroupé dans la « navigation »

Les sources d’information



Les sources d’information

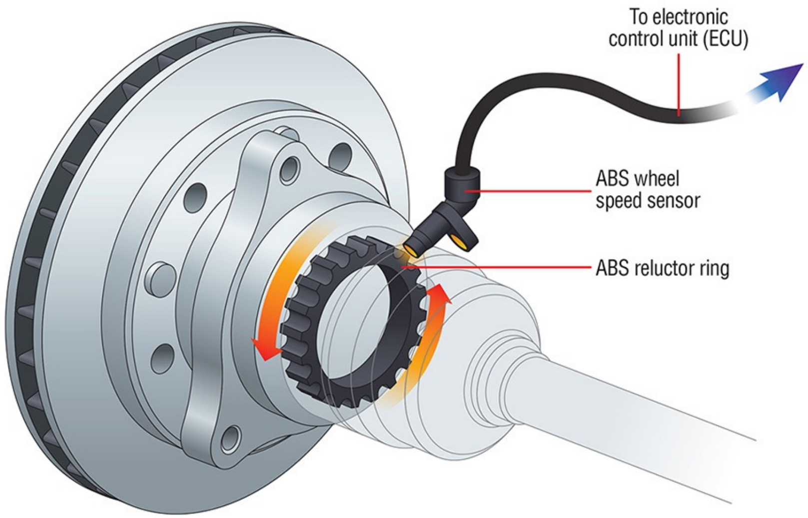
Informations proprioceptives
Informations extéroceptives

Informations proprioceptives

Centrale inertielle

Informations proprioceptives

Odométrie



Informations proprioceptives

Système radar

CORREVIT L-CE-Sensor

A ompact sensor with integrated optics and (E)lectronics for the non-contact and non-slip measurment of ength (distance) and speed on roads, off-road and on rails.

Working Range	1-400 km/h
Frequency Output	350 pulses/m down to 35 pulses/km
Analog Output	12.5, 25, 50, 100 mV/km/h
Linearity	0.2%
Power Supply	9 - 14.5 V/DC, 25W
Operation Temp	-25 ° to + 50 °C
Working Range of the Sensor	300mm ± 60
Dimensions	approx 150 x 60 x 85 mm
Weigh	approx 1.3 kg
Cable Length	5m

Informations extéroceptives

Structured Light

Stereo Camera

Monocular Camera

Radar

Ultrasonic

Planar LIDAR

3D LIDAR

Solid State LIDAR

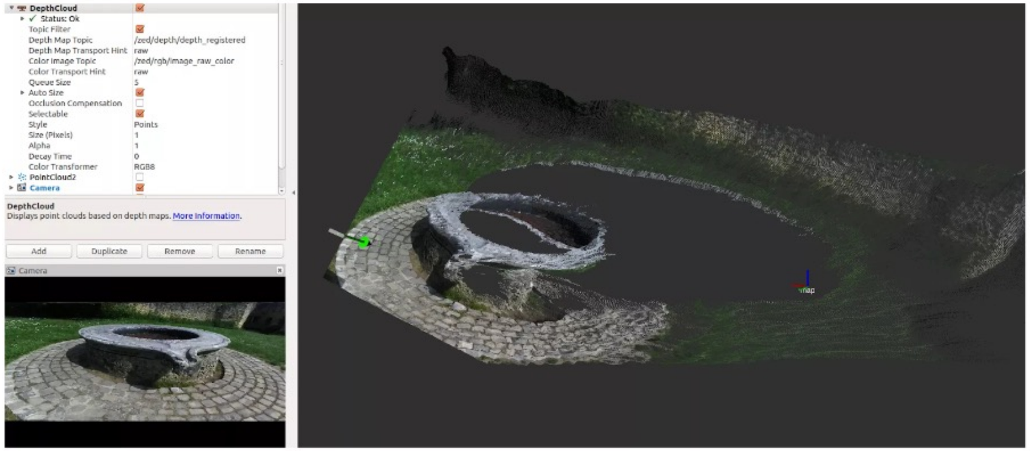
Stereo Camera

Demo Hardware: ZED Camera

Working Principle: Stereo/Multiview Geometry

Advantages: Range, outdoor performance, ‘scalability’

Disadvantages: Low texture surfaces, baseline width determines range, processing requirements.



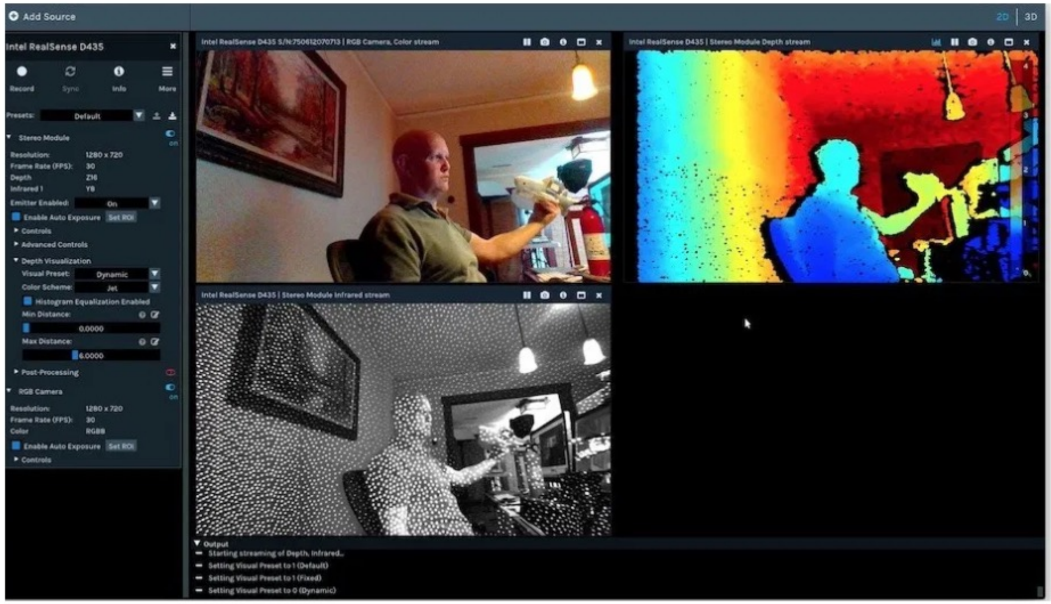
RGB-D Camera

Demo Hardware: Intel Realsense D435i

Working Principle: Active Infrared Stereo

Advantages: 3D pointcloud, works outdoors, properly calibrated IMU

Disadvantages: Limited range, can be noisy, lighting conditions affect performance, requires building Linux kernel



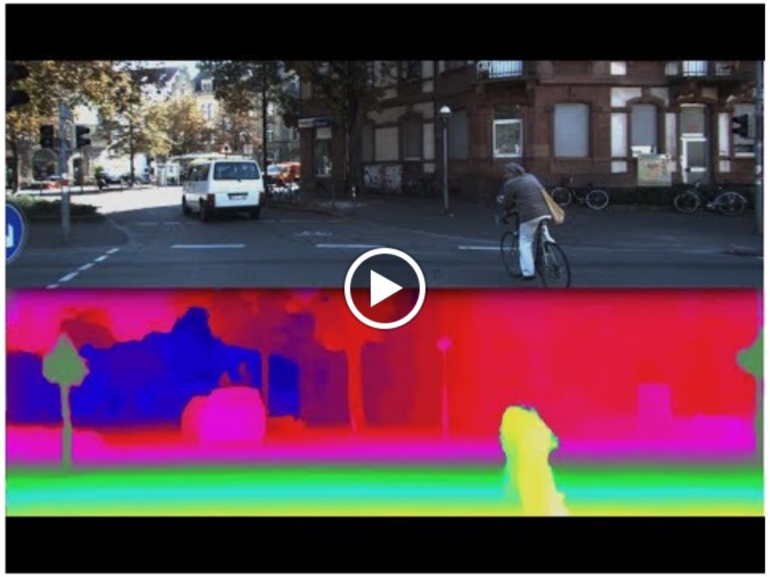
Monocular Depth

Example Hardware: Logitech Webcam & Monodepth Net

Working Principles: Learn from stereo camera data (unsupervised) to map monocular to depth.

Advantages: No special hardware, orthogonal failure modes to other options

Disadvantages: Relative poor accuracy (good for near vs. far questions).



Penn Engineering

Ultrasonic Proximity Sensor

Example Hardware: VEX IQ Ultrasonic Distance Sensor

Working Principle: Measures time of flight of high-frequency sound waves.

Advantages: Accuracy, cost, size

Disadvantages: Range, resolution, only good enough for parking applications (eg. 5m)

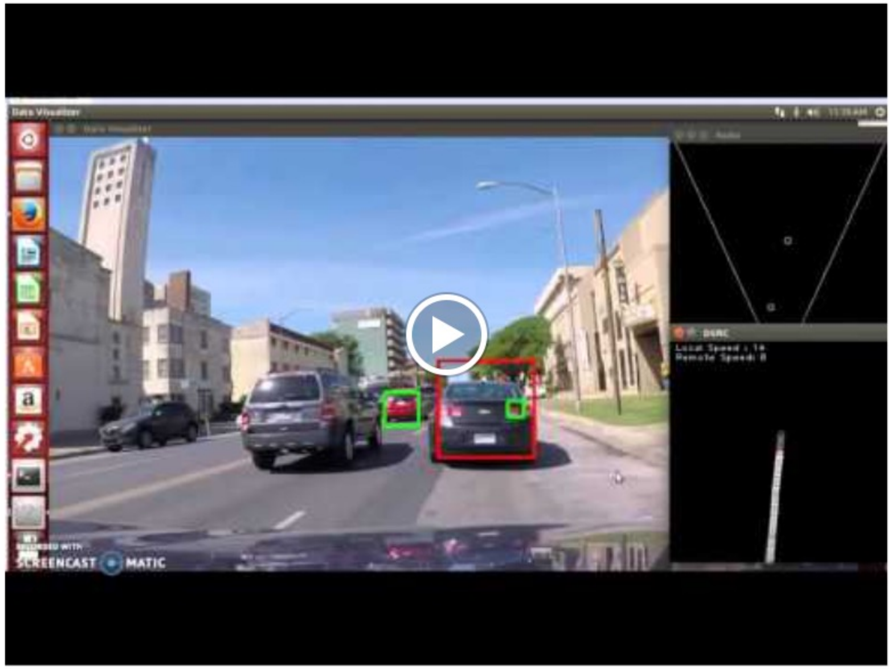
RADAR

Example Hardware: Continental (etc)

Working Principles: Emit RF energy and measure ‘echo’, can use doppler shift etc to get velocity.

Advantages: Cheap, long range, orthogonal failure modes.

Disadvantages: Poor spatial resolution and field of view, false positives on overhead signs etc.



Penn Engineering

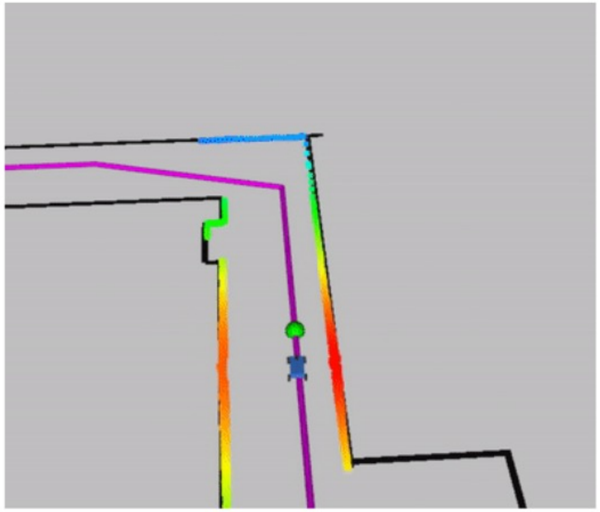
Planar LIDAR

Demo Hardware: Hokuyo 30LX

Working Principle: Time-of-flight using laser.

Advantages: Relatively low cost, simple data structure, high update rate, low processing requirements

Disadvantages: Primarily working in flat environments, harder to detect objects etc.



3D LIDAR

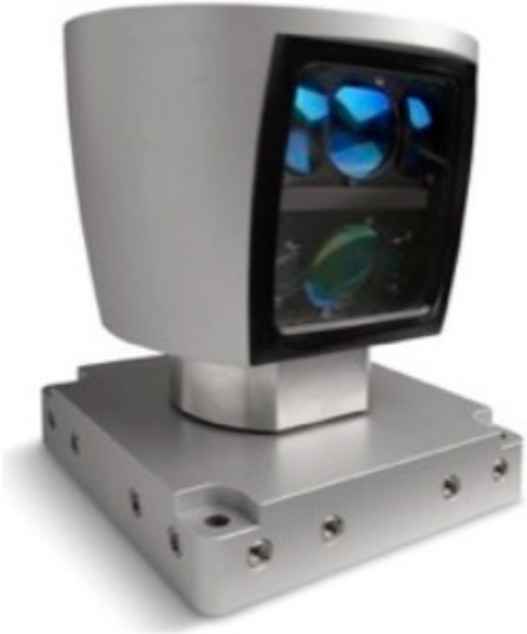
Demo Hardware: Ouster OS-2

Working Principle: Time-of-flight, laser, note different wavelength of this product

Advantages: Full 3d information, can get image like information

Disadvantages: Cost, reliability (mechanical), processing point cloud.

Télémètre rotatif multinappe



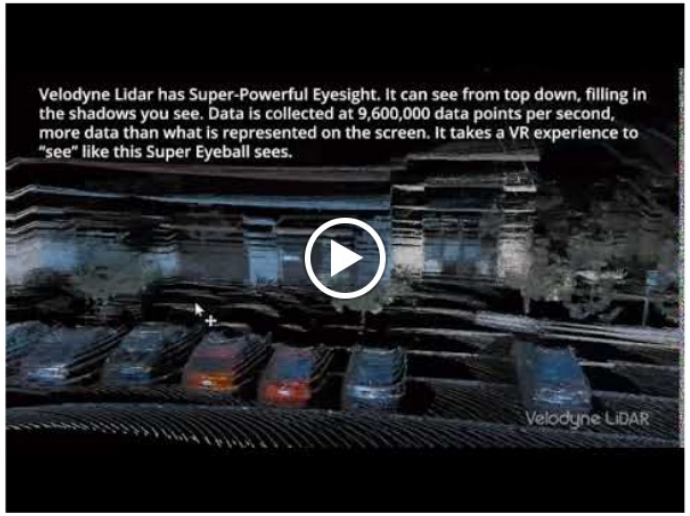
Solid-State LIDAR

Demo Hardware: Velodyne Velarray

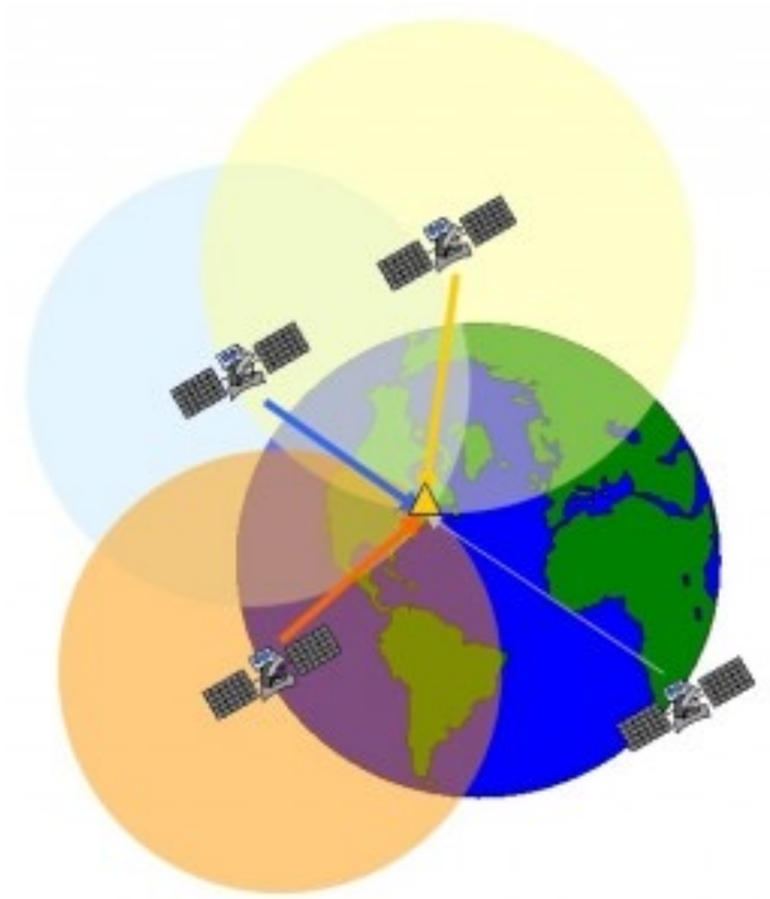
Working Principle: Time-of-flight, steer laser with solid-state components.

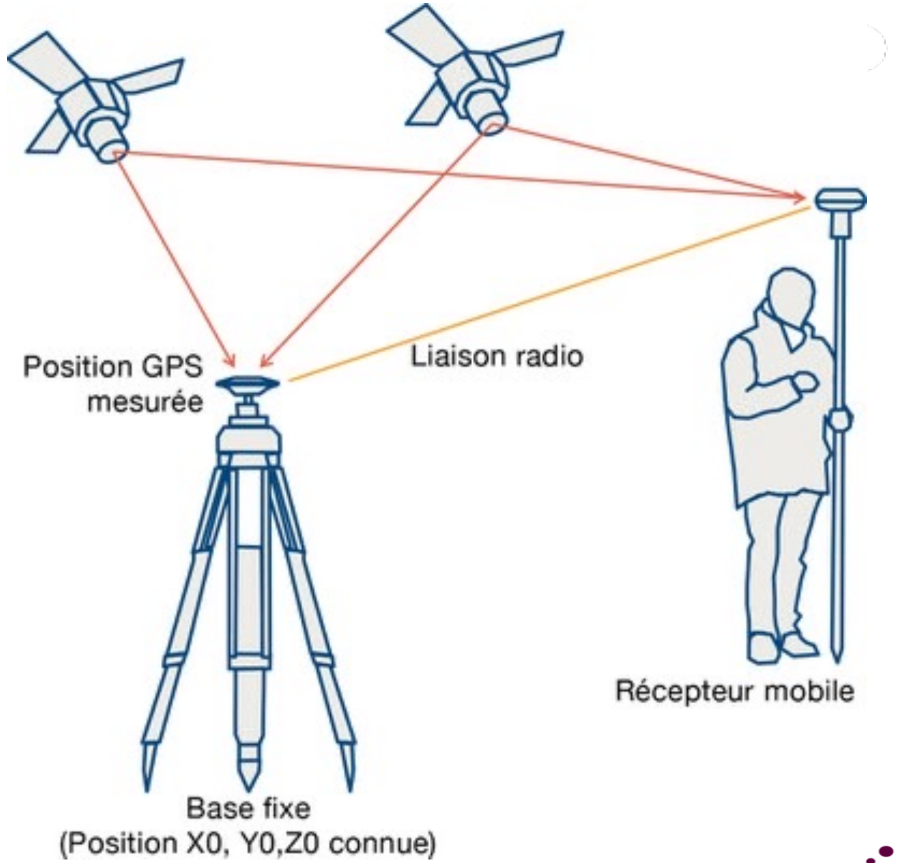
Advantages: Compact, no moving parts, range etc

Disadvantages: Field of view, availability, technical feasibility.



GPS




Position GPS
mesurée
Liaison radio
Récepteur mobile
Base fixe
(Position X0, Y0,Z0 connue)

Le Thymio

Motorisation ?

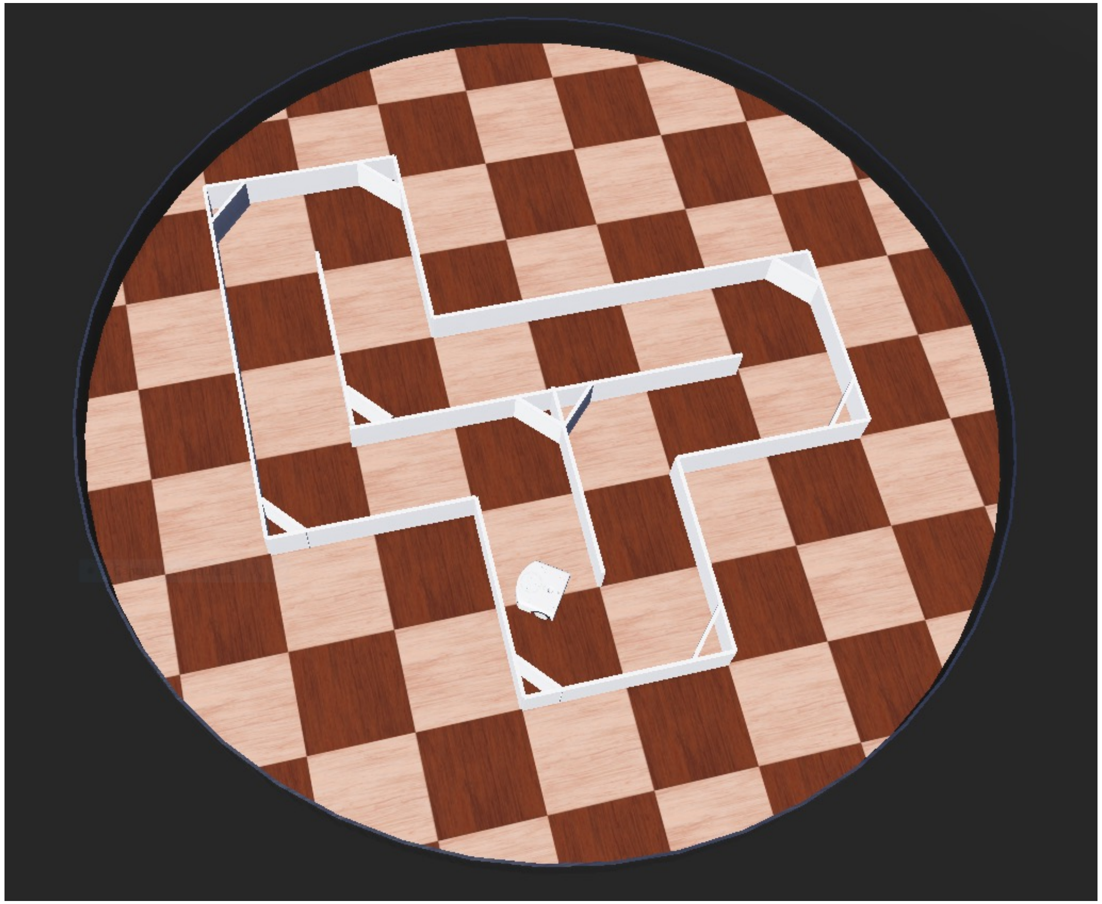
Capteurs proprio ?

Capteurs extero ?

Programmation ?

https://www.thymio.org/fr/

Webots – Simulateur (Thymio)



Webots – Simulateur (Thymio)

Sujet disponible sur Ecampus

- Prendre en main le simulateur Webots et ses outils de développement
- Découvrir le robot Thymio et ses capteurs embarqués
- Développer un premier algorithme simple