PhD on bio-inspired route following task

Gabriel Gattaux

Encadrants :
Franck Ruffier
Julien Serres
Antoine Wystrach (CRCA)

Cataglyphis velox © Michael Mangan and Hugh Pastoll
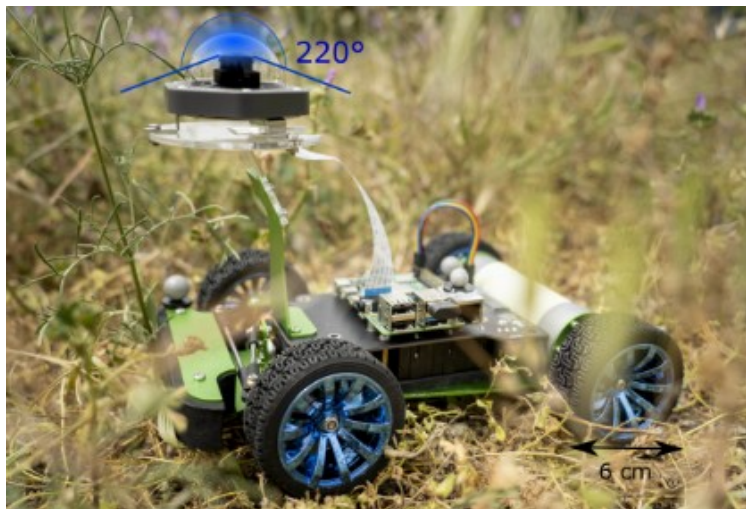
VOST Collectif / Institut Carnot STAR

Cataglyphis velox ©A. Wystach/CRCA

How ants navigates ?

Cataglyphis bicolor   Cataglyphis fortis   Melophorus bagoti
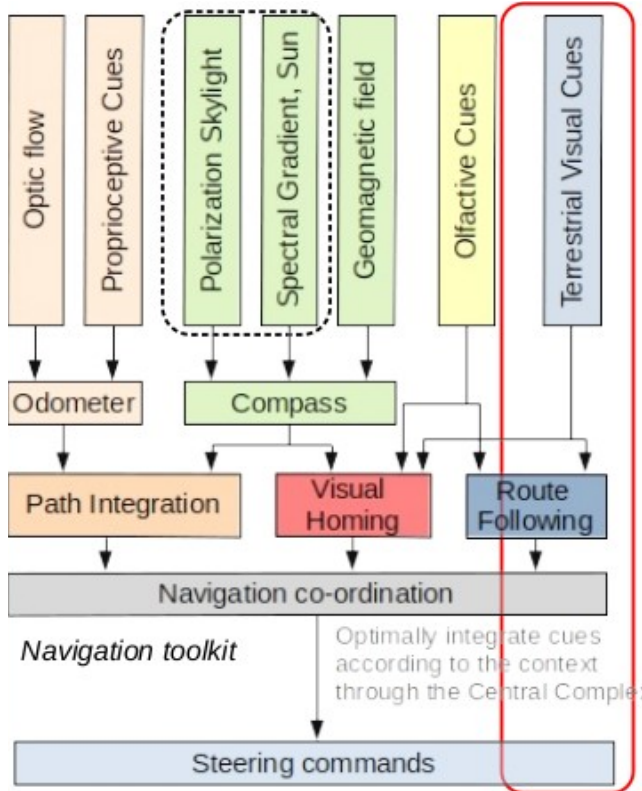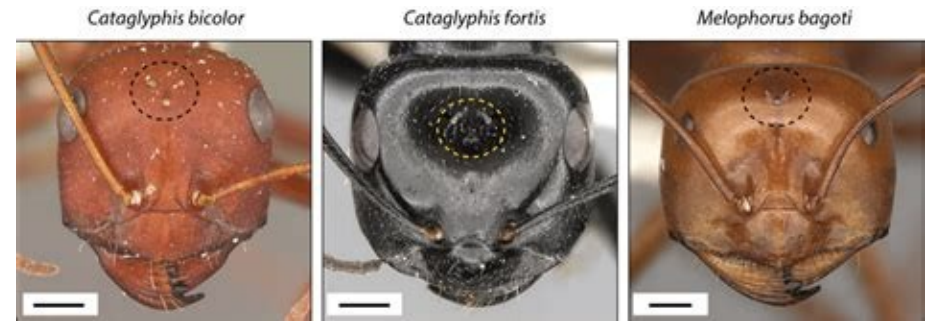
2019 - Pentchma et al, Ocellar structure of African and Australian desert ants
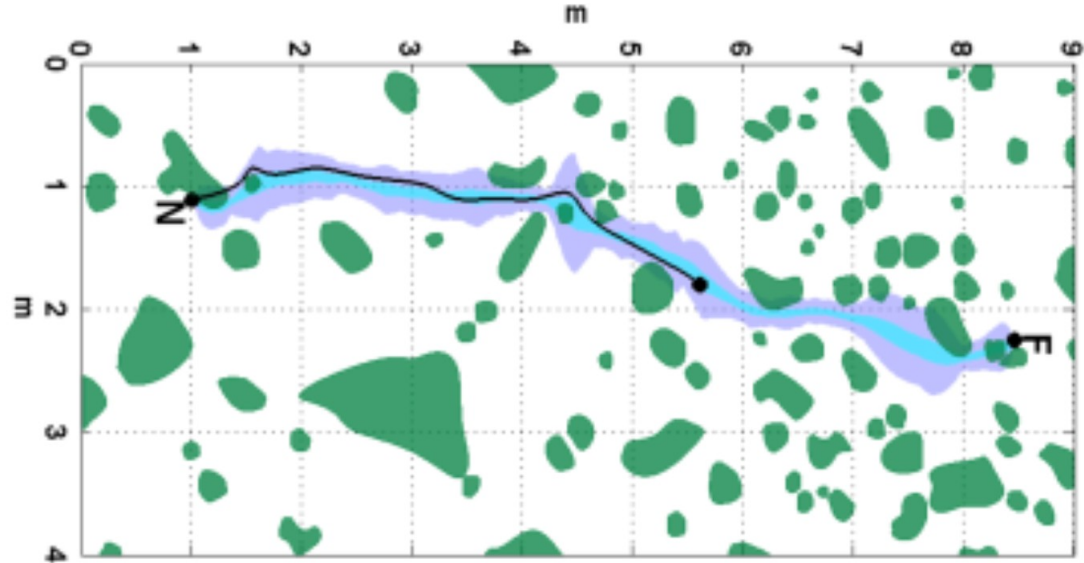
Sun et al, elife,2020

Mangan & Webb, behavio. Eco. 2012

Gabriel Gattaux

What's inside ants brain ?

- - -► catch and release
--- habitual route
--- path integration (PI)
--- visual homing (VH)
--- route following (RF)

Nest
RF
PI + VH
VH
Full-Vector
Zero-Vector
Feeder

Sun et al, elife,2020

Mushroom bodies
Antennal lobe
Lateral accessory lobe
Central complex
Lamina
Medulla
Lobula
Anterior optic tubercle
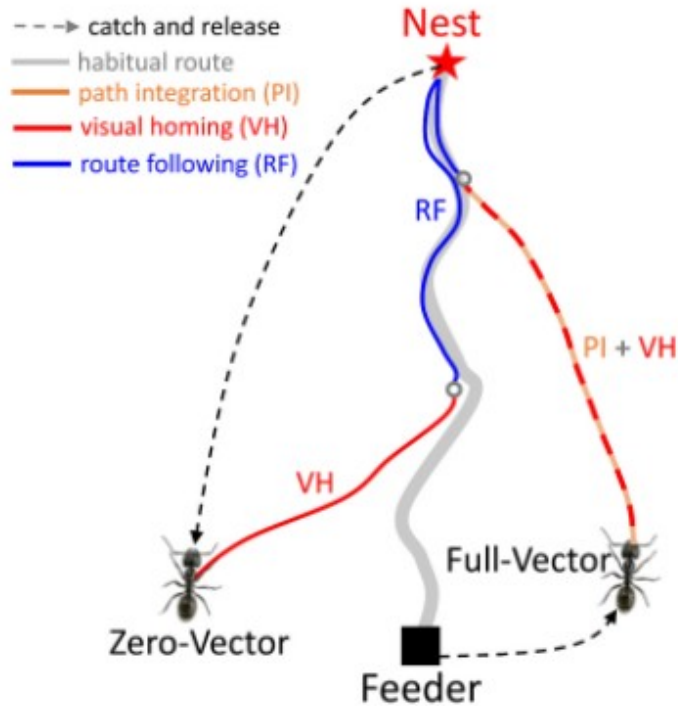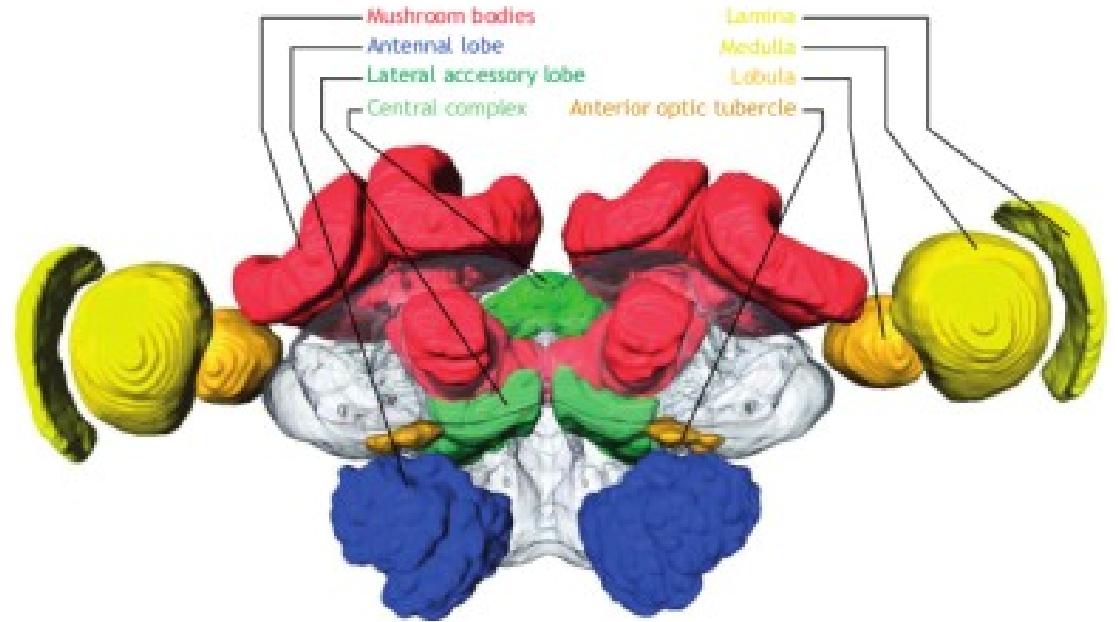
F. Steinbeck, Journal of Experimental Biology, 2020

3

Gabriel Gattaux

Basic Neural model w olfactory source
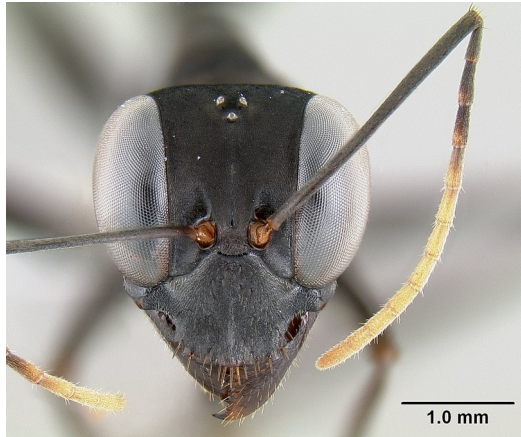
Gigantiops destructor, antweb
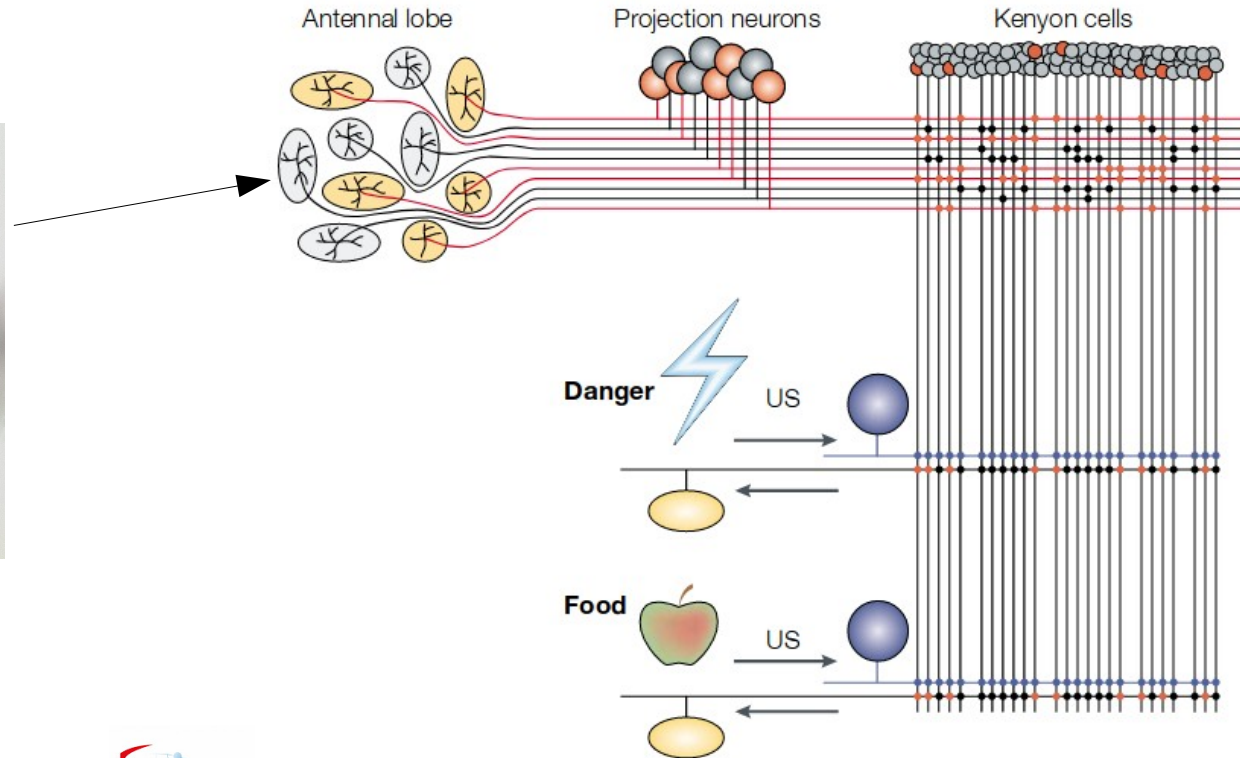
Heinsenberg 2003, Nature

4

Gabriel Gattaux

Ants simulation – Familiarity over space
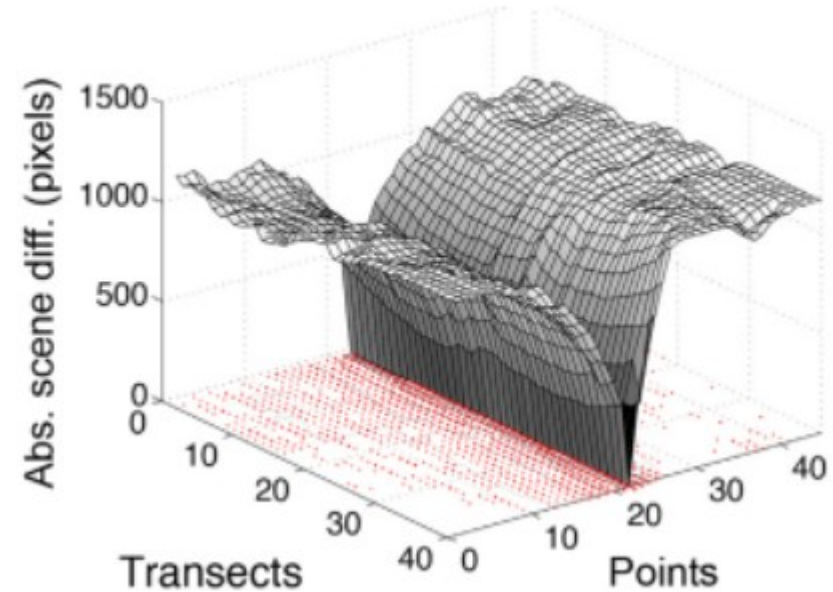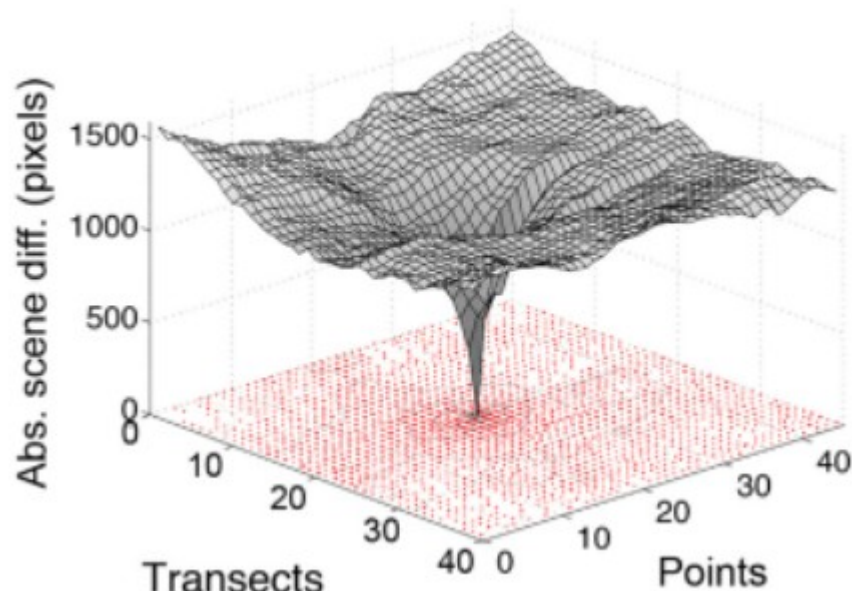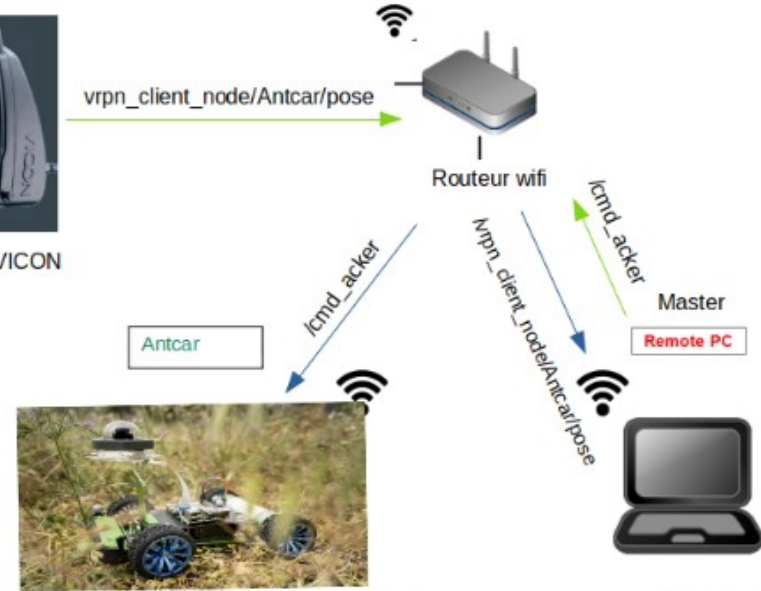

Gaffin et al, plos one, 2016

Gabriel Gattaux
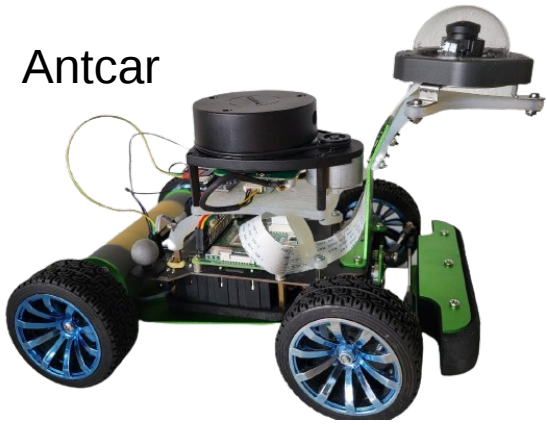
Robotics implementation
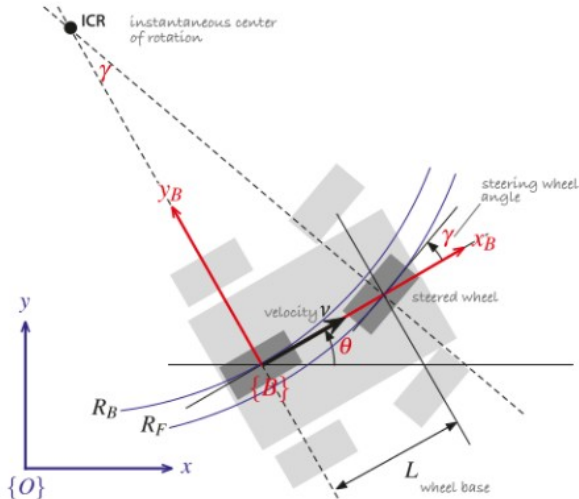
Antcar

P.corke et al, Robotics vision and control, 2011

ICR — instantaneous center of rotation

steering wheel angle

steered wheel

velocity V

L wheel base

R_B

R_F

vrpn_client_node/Antcar/pose

Routeur wifi

Systeme de camera VICON

/cmd_acker

vrpn_client_node/Antcar/pose

/cmd_acker

Master

Remote PC

Antcar

ROS_MASTER_URI = http://IP_OF_REMOTE_PC:11311
ROS_HOSTNAME = IP_OF_ Antcar

ROS_MASTER_URI = http://IP_OF_REMOTE_PC:11311
ROS_HOSTNAME = IP_OF_REMOTE_PC

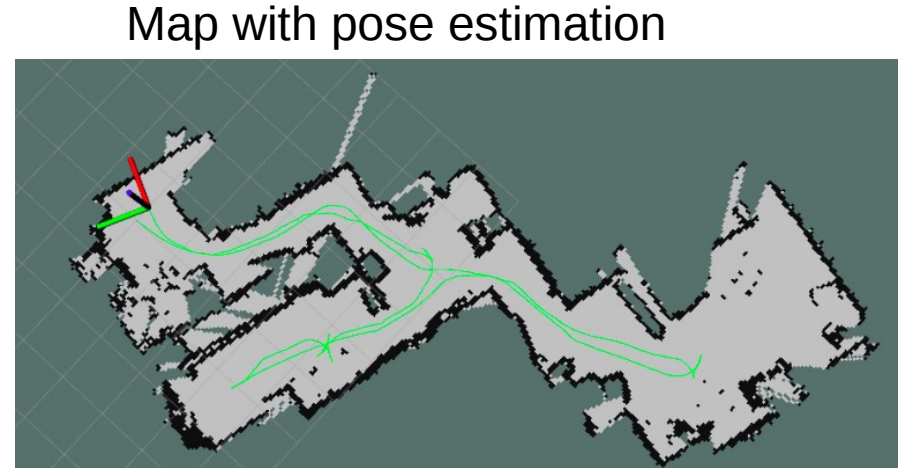* Example when ROS Master is running on the Remote PC
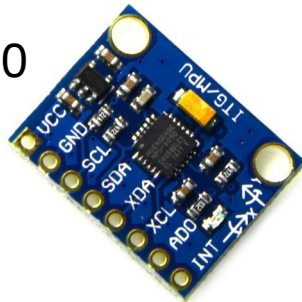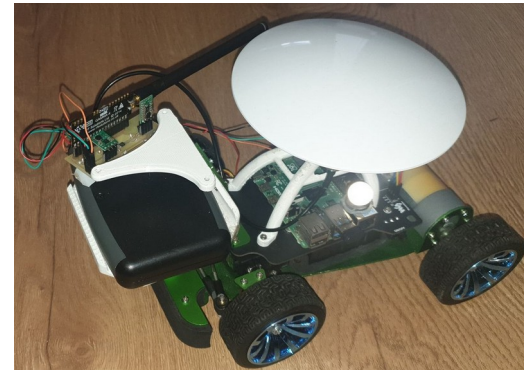
Figure 25: Communication environment

Gabriel Gattaux

INSTITUT DES SCIENCES ETIENNE DU MOUVEMENT JULES MAREY

Aix*Marseille université

CRCA

AGENCE INNOVATION DÉFENSE

DGA

Biorobotique

Ground truth without VICON

RPLIDAR A1
360° Laser Range Scanner

12 meters Range 360 Degree Omnidirectional 8000 per time samples 5.5 HZ OPTMAG Technology

hector_slam →

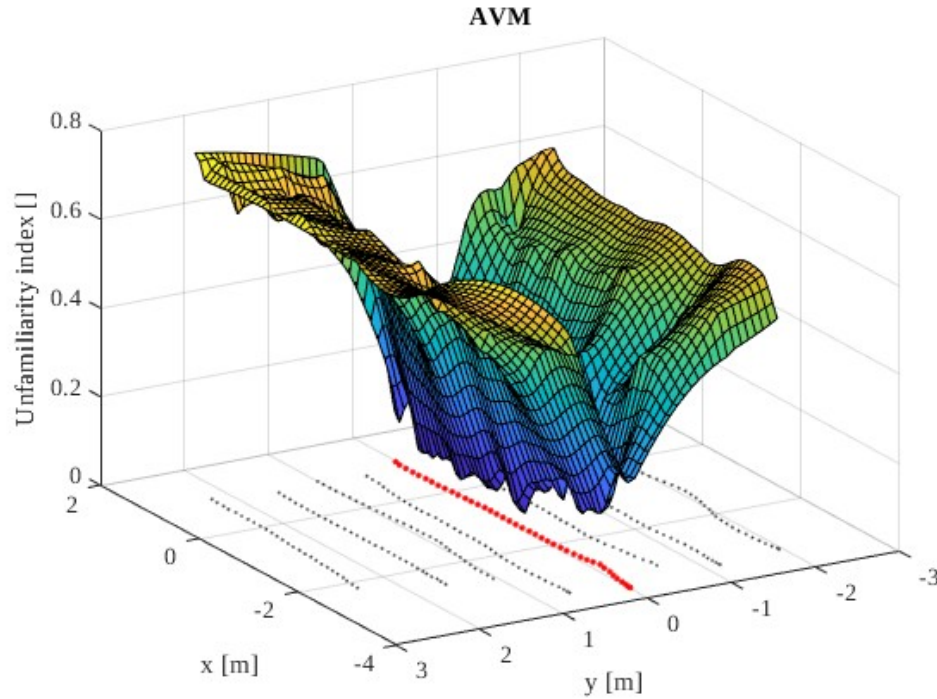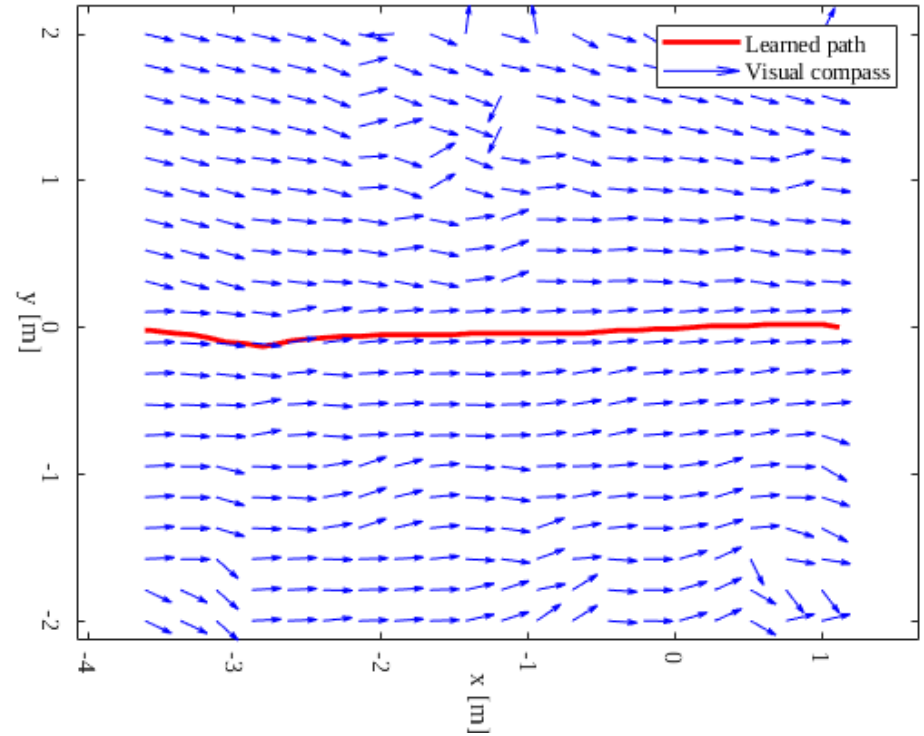Map with pose estimation

MPU6050

GPS + RTK

Cross track error

Vectors fields

In "Arene de Vol de la Méditterranée"

Finding the direction that maximize the familiarity based on vision sensor **alone** work indoor and outdoor

INSTITUT DES SCIENCES ETIENNE DU MOUVEMENT JULES MAREY

Aix*Marseille université

Biorobotique

CRCA

AGENCE INNOVATION DÉFENSE

DGA

Thanks for watching

gabriel.gattaux@univ-amu.fr