La robotique à l'ENSTA Bretagne

Fabrice LE BARS

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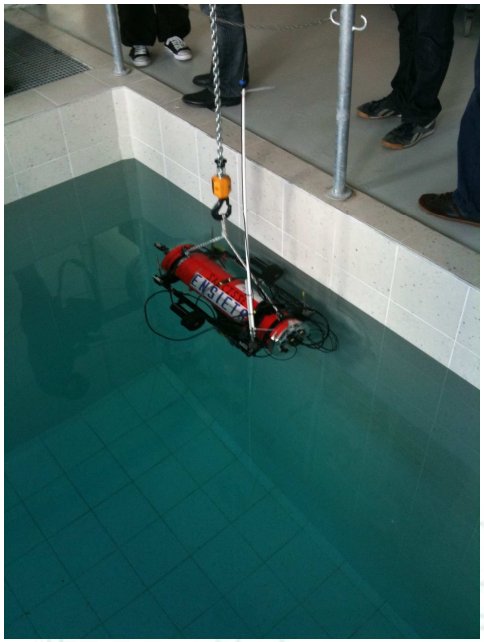
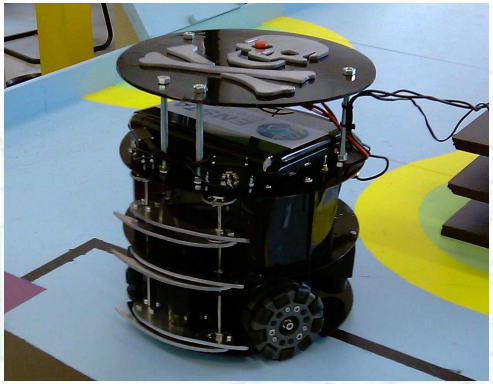
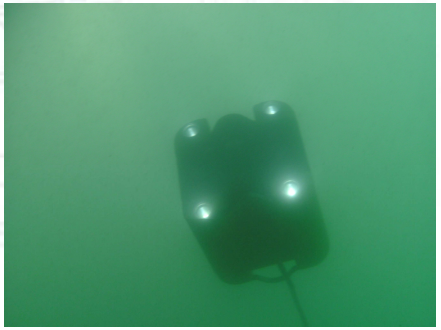
- Présentation
- Principaux robots et concours
- Autres robots
- Organisation

Présentation

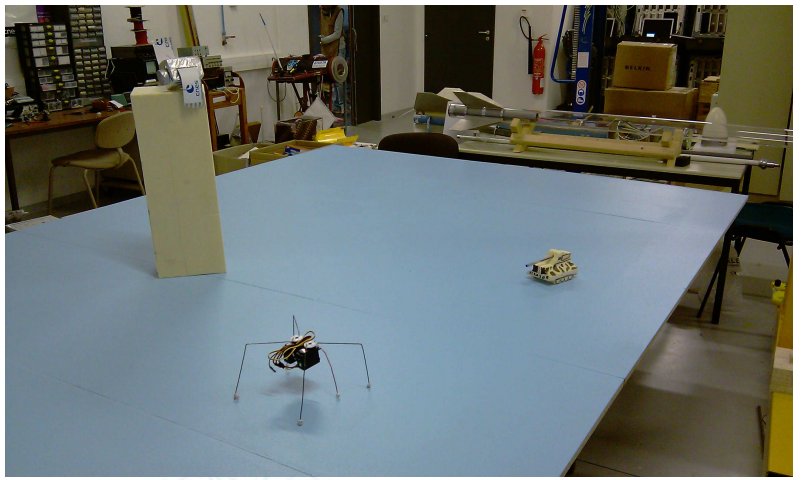


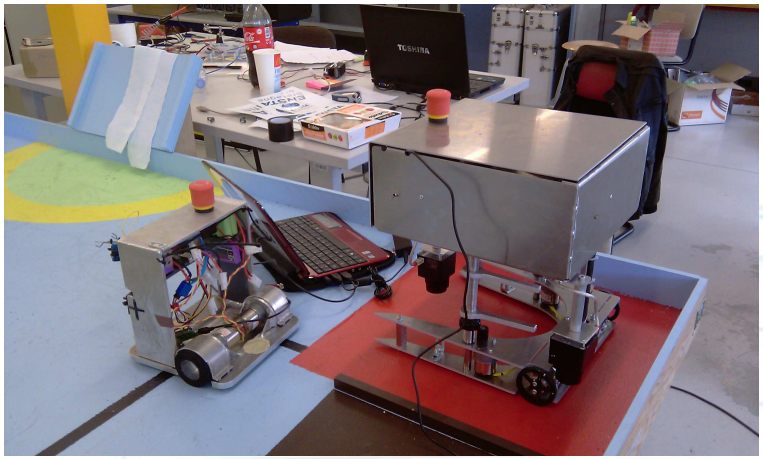


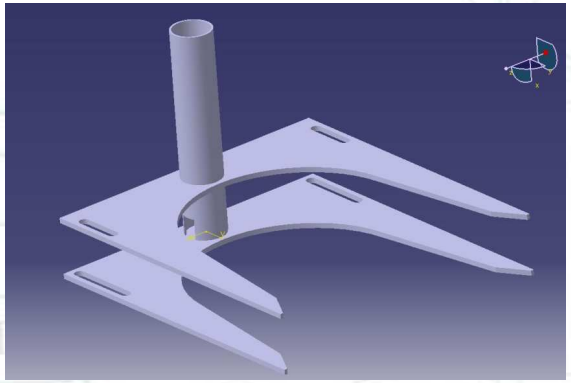


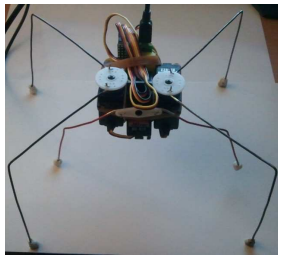
Présentation

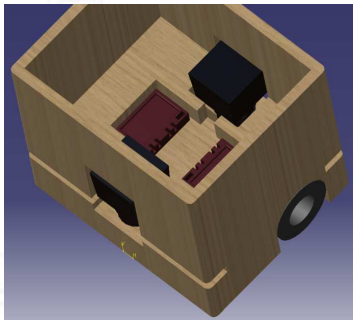
- Activités extra-scolaires :
  - Initiation au traitement d'images, contrôle de moteurs sur PC en C/C++, CAO
  - Préparation Coupe de France de Robotique





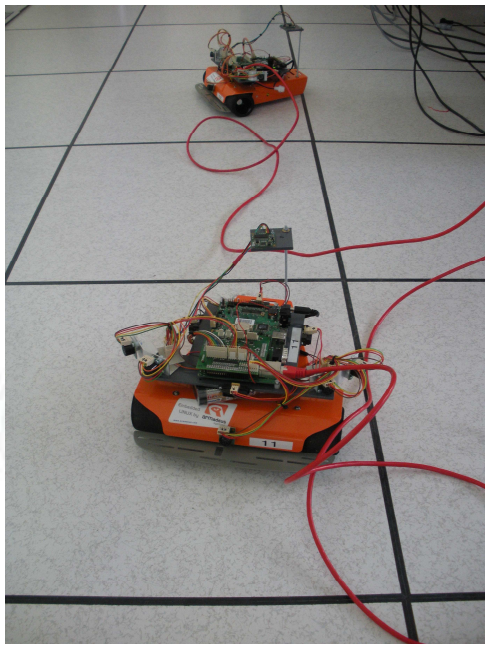






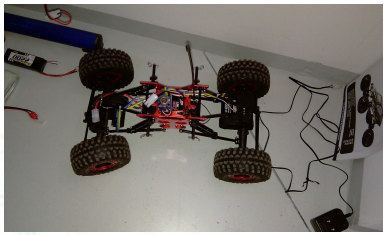
Présentation

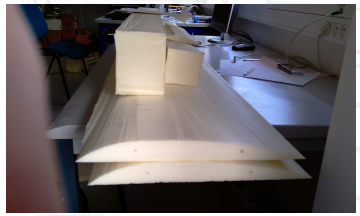
- Cours en lien avec la robotique
  - Automatique
  - Méthodes ensemblistes pour la robotique
  - TP sur robots JOG (ENSI 1, FIPA 3)
  - …

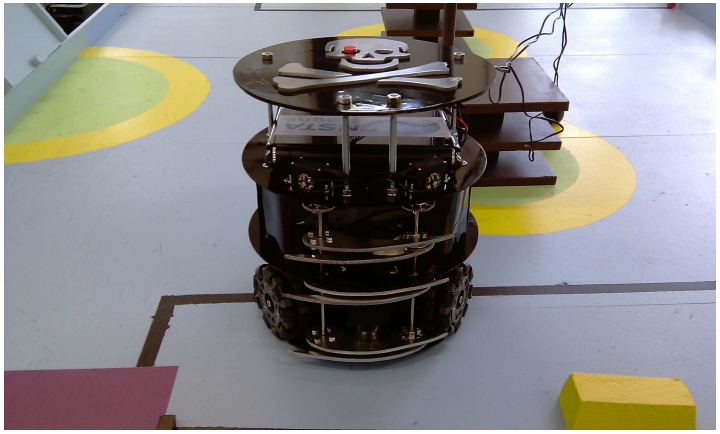


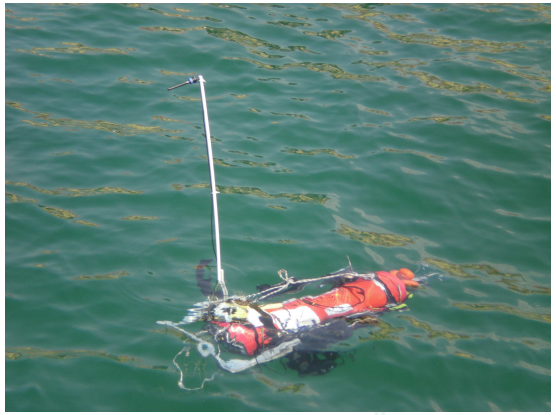
Présentation

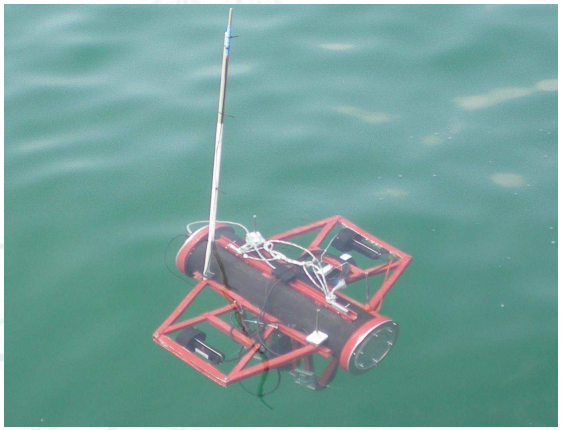
- Projets industriels ENSI 2 / Applications système ENSI 3
  - Robots voiliers / radeaux autonomes
  - Sous-marins SAUC-E
  - Jeu des buggys
  - Régulation d'un vélo
  - Cerf-volant / planeur







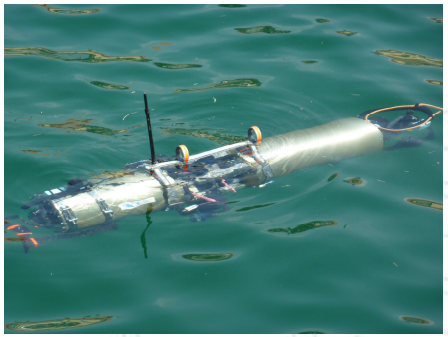
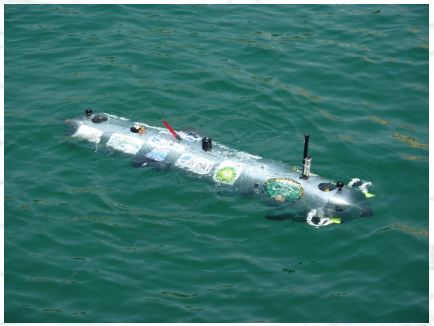


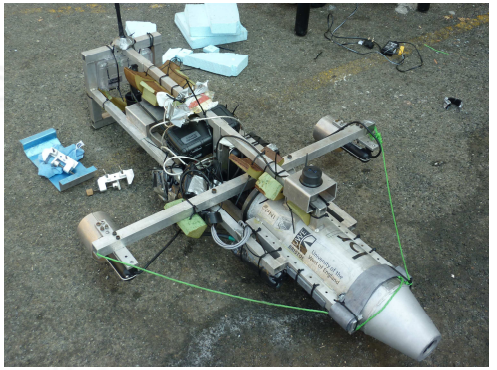


Principaux robots et concours

Principaux robots et concours

- SAUC-E (Student Autonomous Underwater Challenge - Europe)
  - Concours de robots sous-marins autonomes dans une piscine ou un port
  - Missions : passer à travers des cadres, détecter et localiser différents objets par sonar ou camera,…

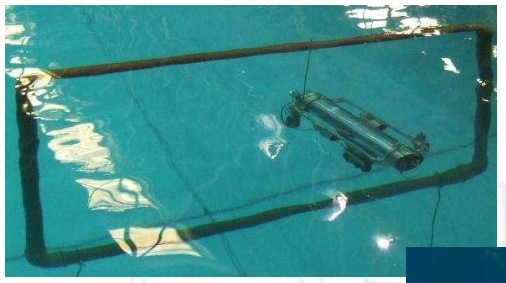



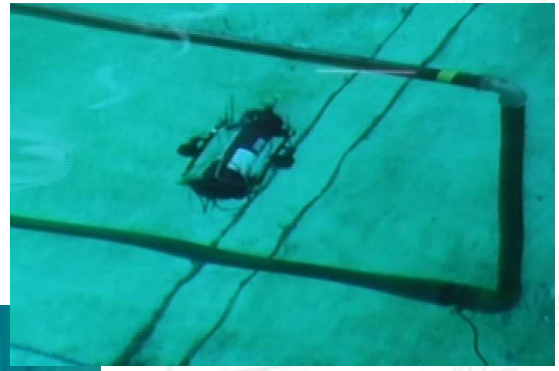


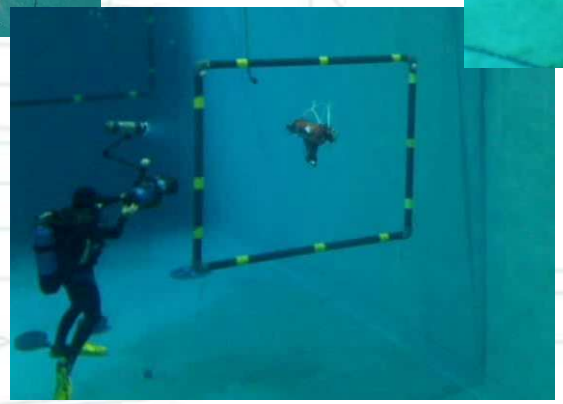
Principaux robots et concours

Principaux robots et concours

- SAUC-E (Student Autonomous Underwater Challenge - Europe)
  - 5 participations au concours depuis 2007 (2ème à 4ème sur une dizaine de concurrents chaque année)

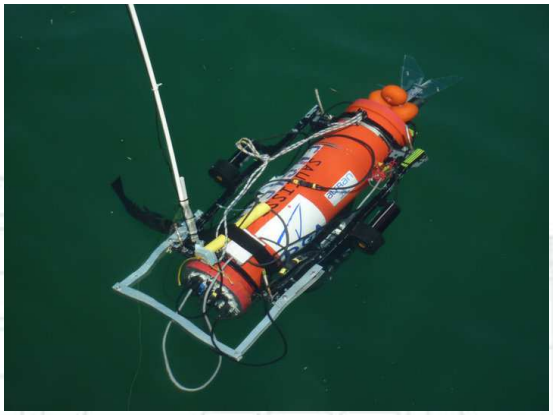


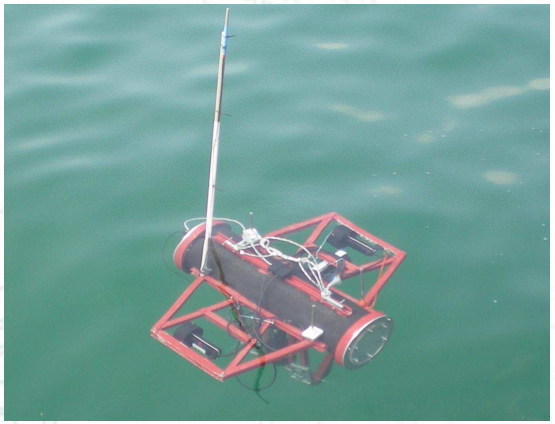




Principaux robots et concours

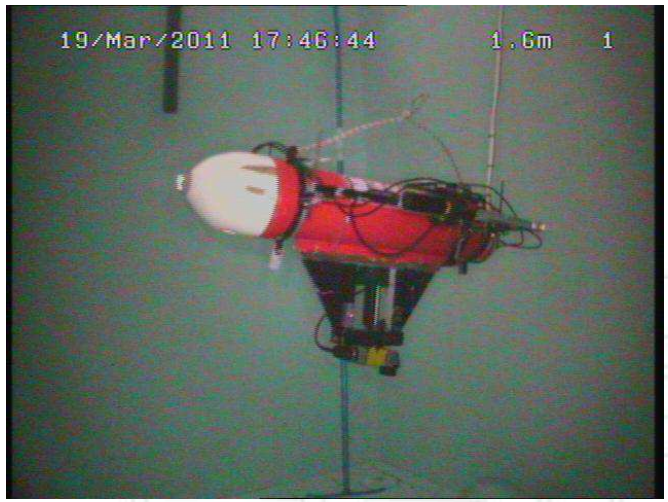
- SAUC-E (Student Autonomous Underwater Challenge - Europe)
  - 2 robots sous-marins : SAUC'ISSE (construit en 2007) et SARDINE (construit en 2010)

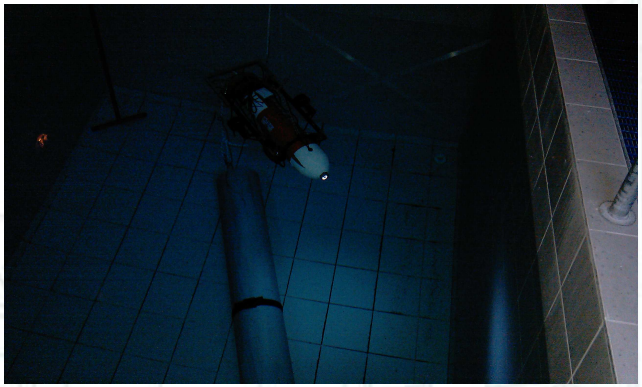
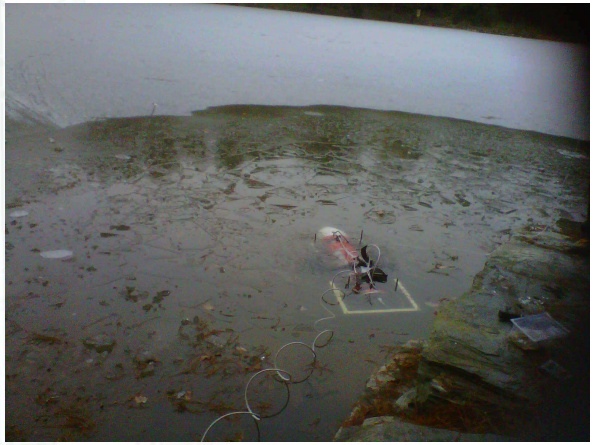




Principaux robots et concours

- SAUC-E (Student Autonomous Underwater Challenge - Europe)
  - SAUC'ISSE



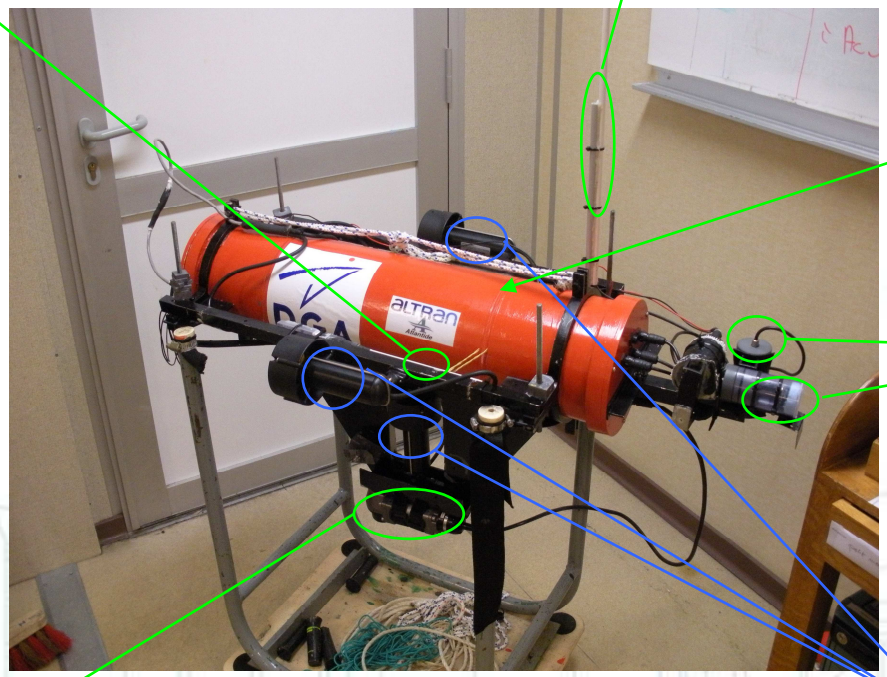



Principaux robots et concours

Switch :
It is a home-made watertight switch.

WIFI antenna :
It allows the communication with an external computer (up to a depth of 1 m).

Aluminium tube :
The submarine is based on an aluminium tube of 80 cm with a diameter of 20 cm. It contains the embedded electronics and the batteries. It is closed by 2 aluminium covers with IP68 connectors to connect the external peripherals with the internal devices.

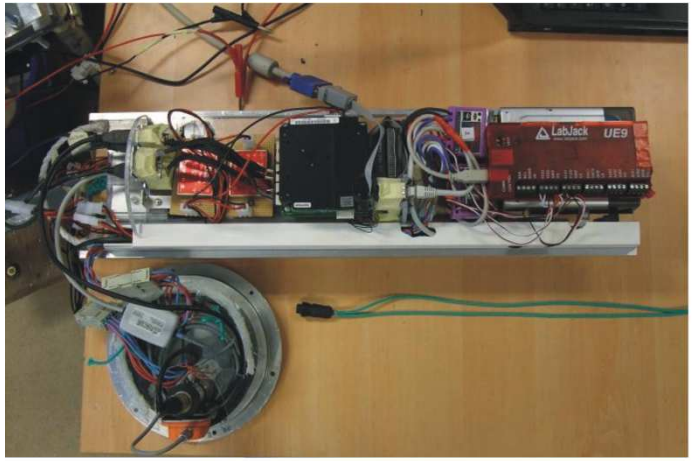


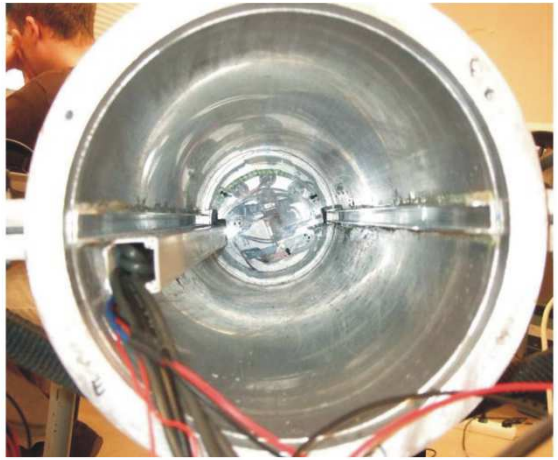
Cameras :
We use 2 watertight cameras to locate different objects in the water.

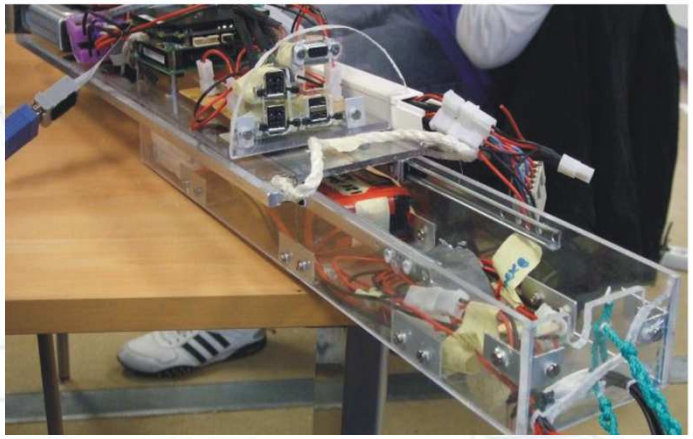
Thrusters :
2 horizontal thrusters handle the speed and the direction of the robot.
1 vertical thruster controls the depth.
The submarine is stable thanks to a heavy keel which is also used to hold the sonar and the vertical thruster.

Sonar :
The sonar is used to localize the submarine by trying to detect the borders of the water area. The sonar makes a continuous scan of 360°.

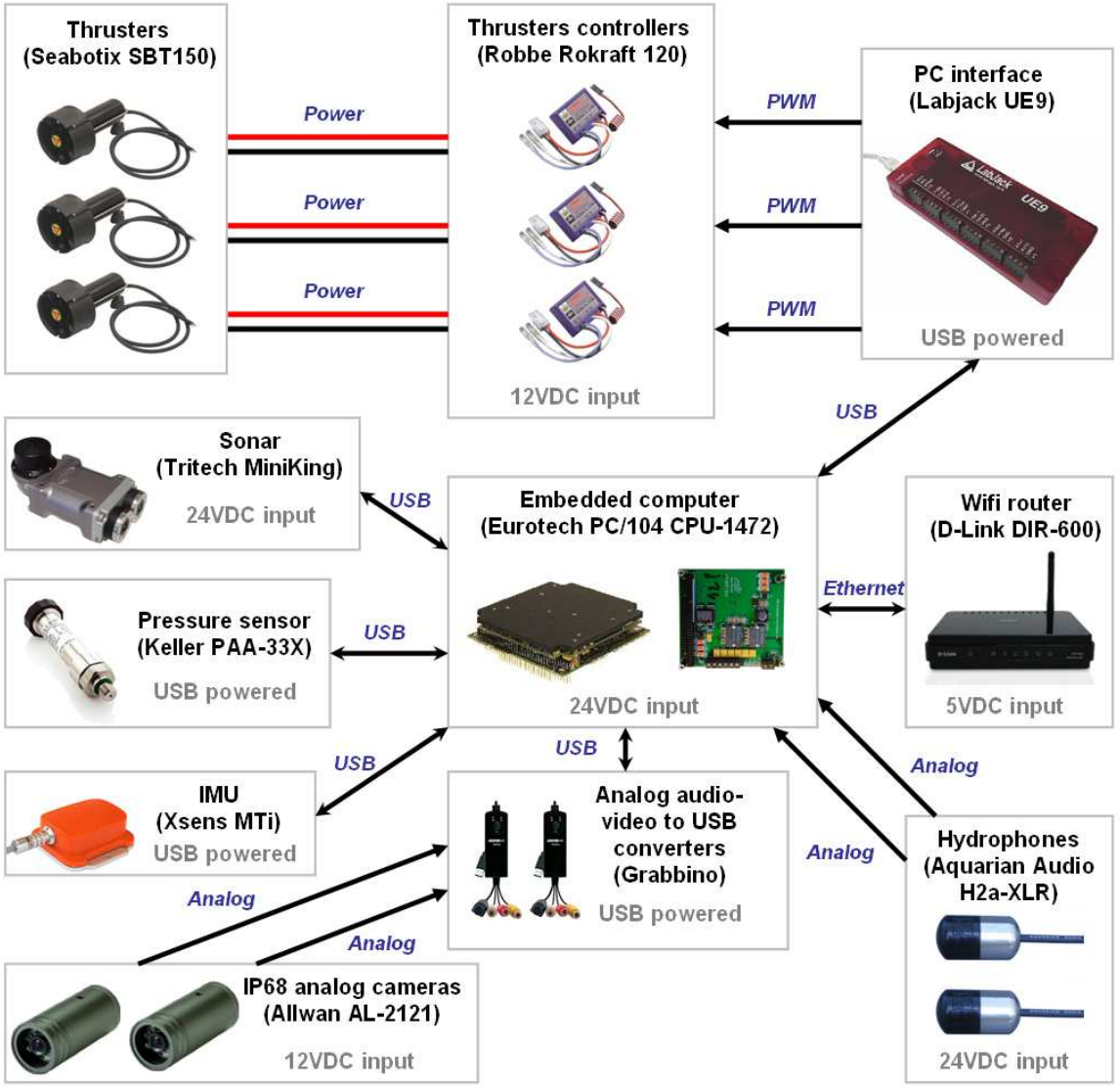
Principaux robots et concours



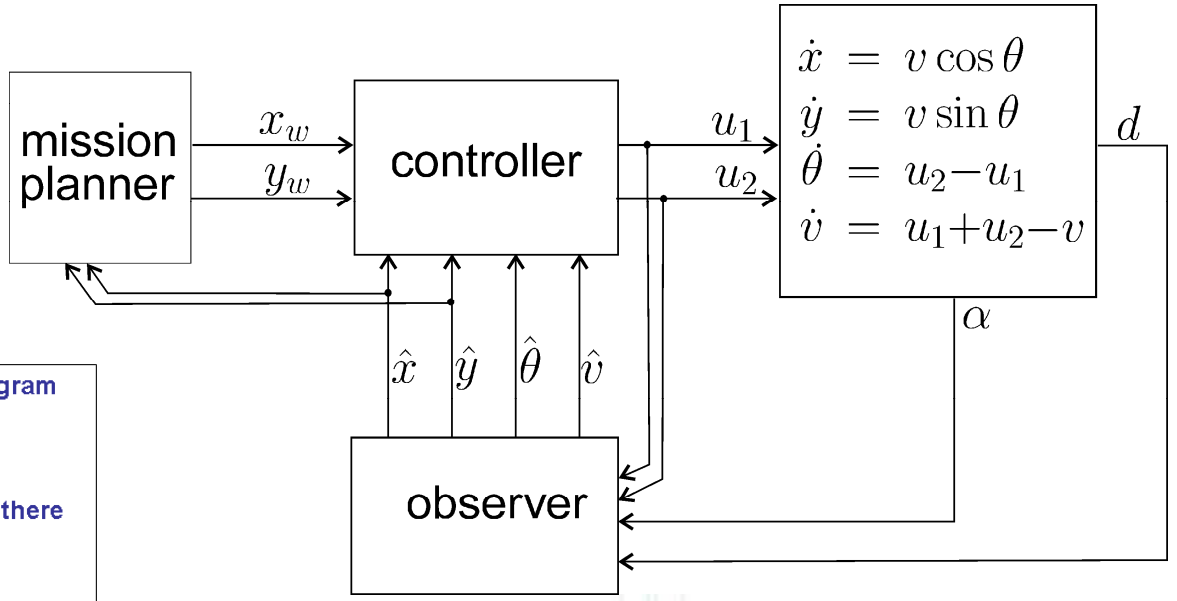




Principaux robots et concours



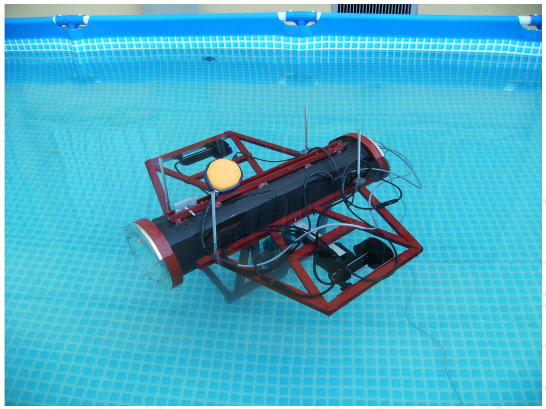
Principaux robots et concours

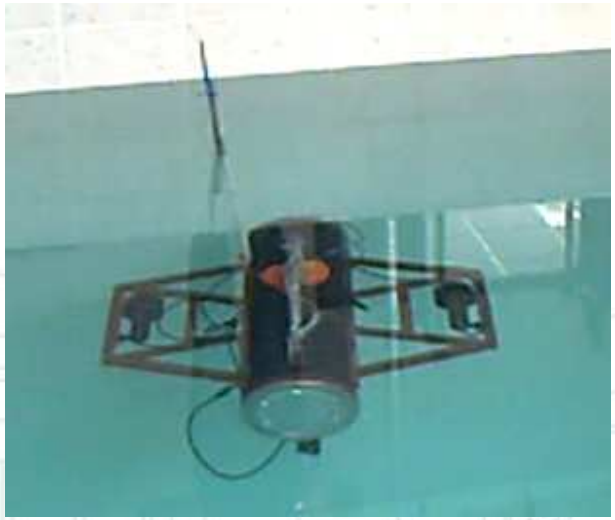


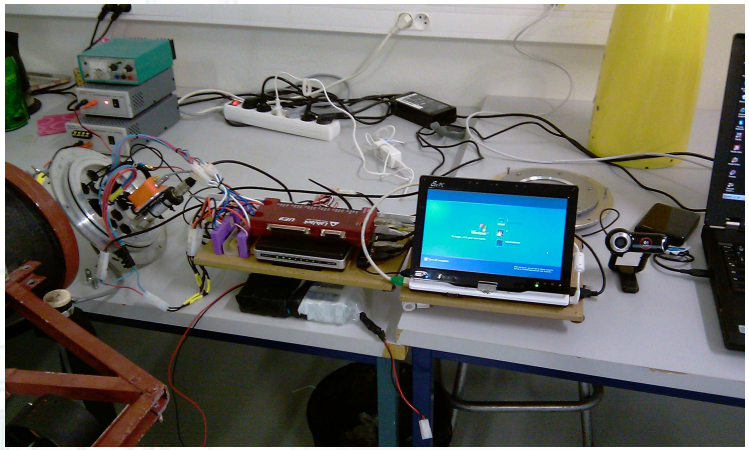

```
% this is a commentary. It is ignored by the program
% Example 1: go to depth -3m
%% step1: start depth regulation
depthreg -3
%% step2: wait 15s for the robot to actually get there
wait 15
% Example 2: some random movements at -3m
heading 1
wait 5
thrust 1
wait 10
stop
heading 1.57
wait 10
% Example 3: high level action
configureWallFollowing 12.5 1.2 -1.57 0 0.3 0.2 0.5
startWallFollowing
wait 20
stopWallFollowing
generalstop
depthreg 0
```

Principaux robots et concours

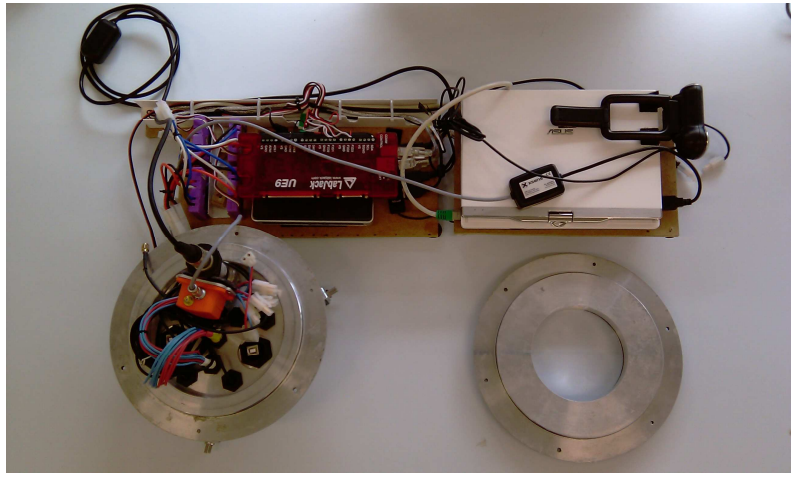
- SAUC-E (Student Autonomous Underwater Challenge - Europe)
  - SARDINE

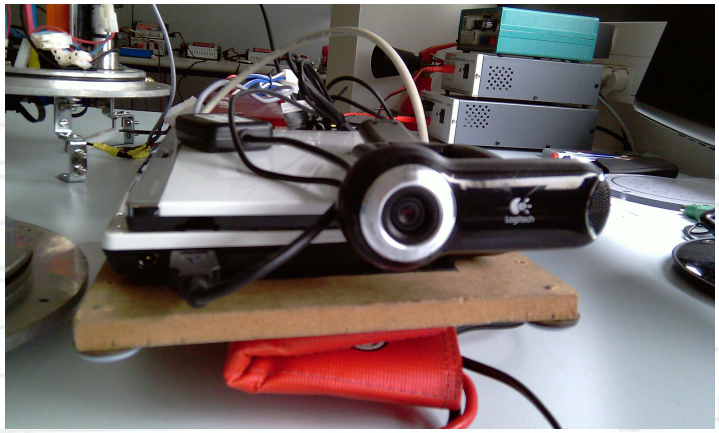


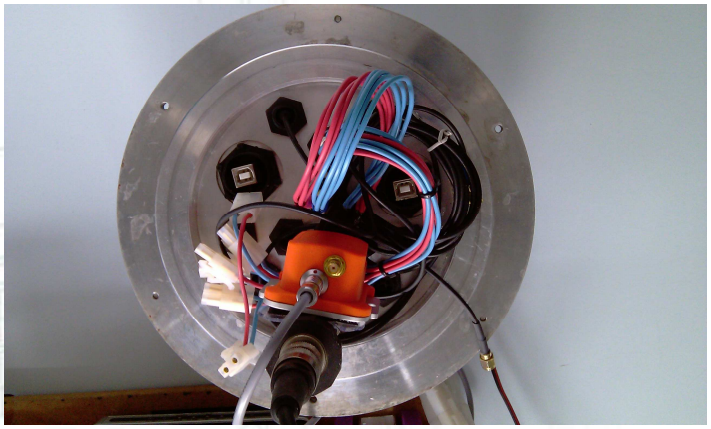




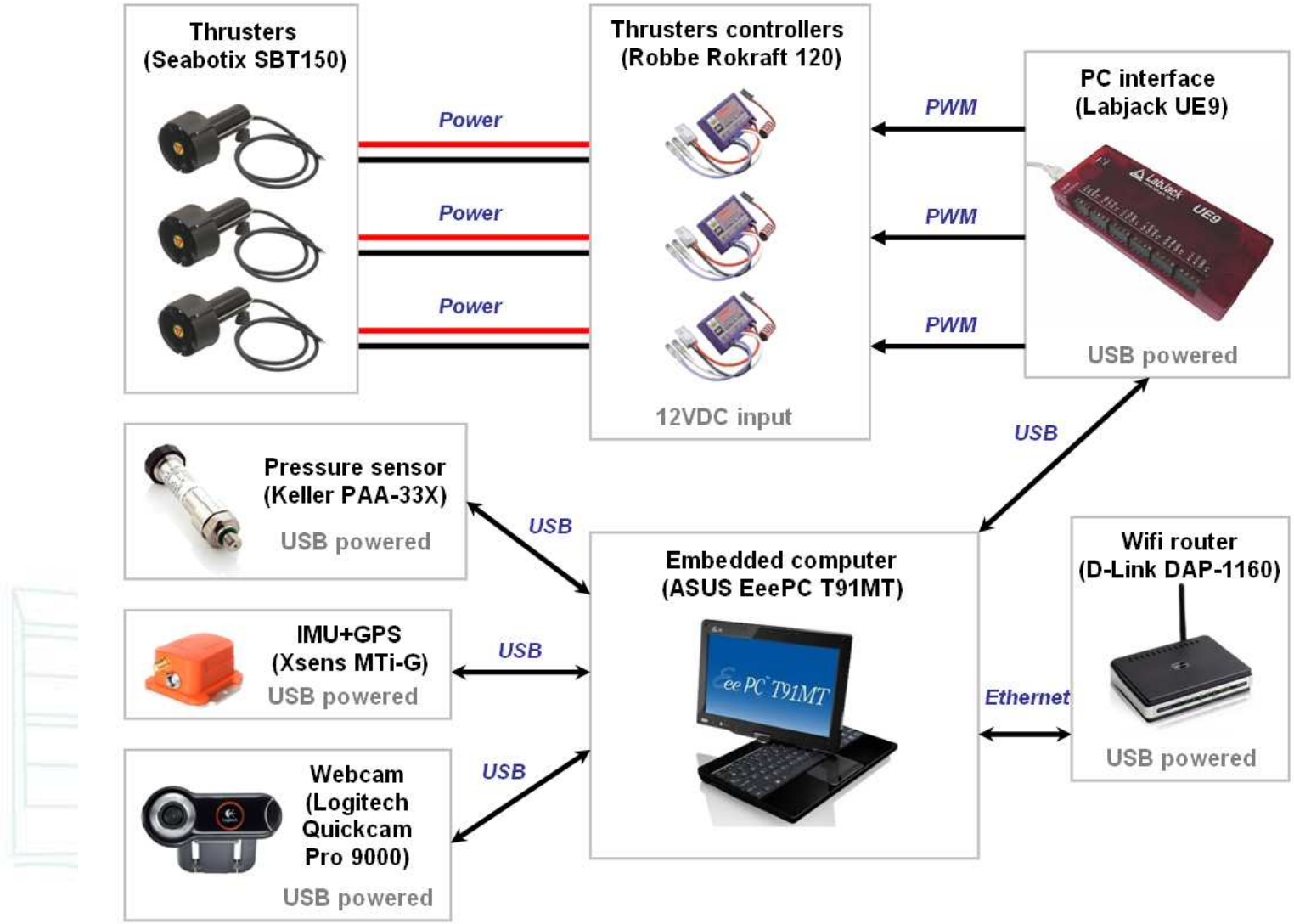
Principaux robots et concours



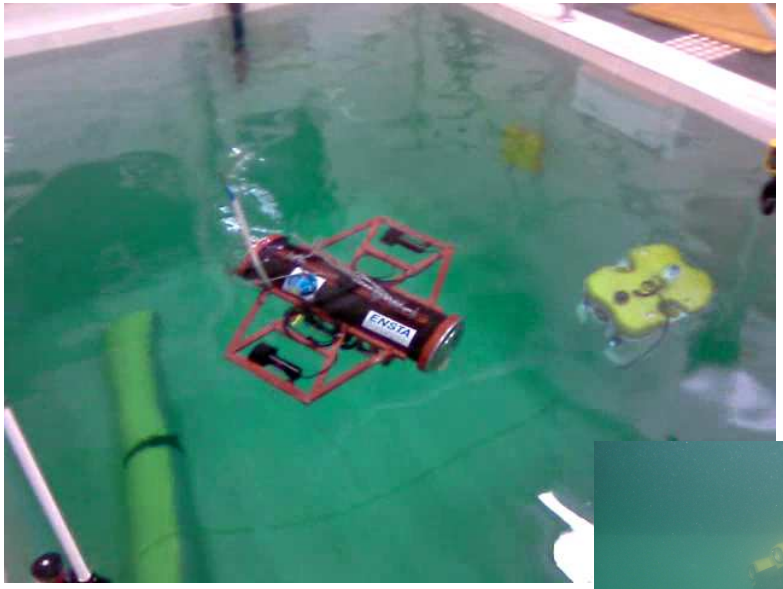


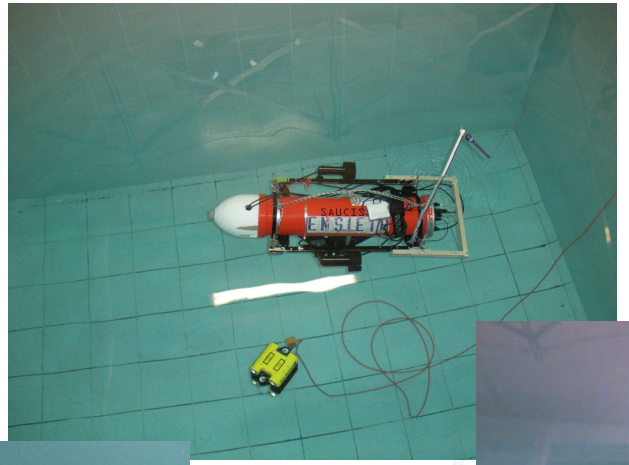


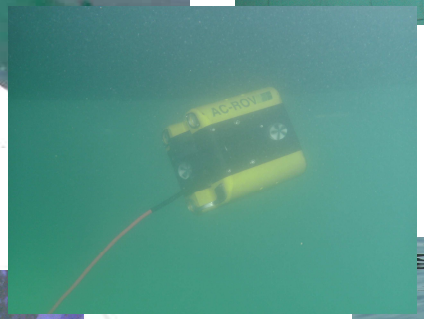
Principaux robots et concours

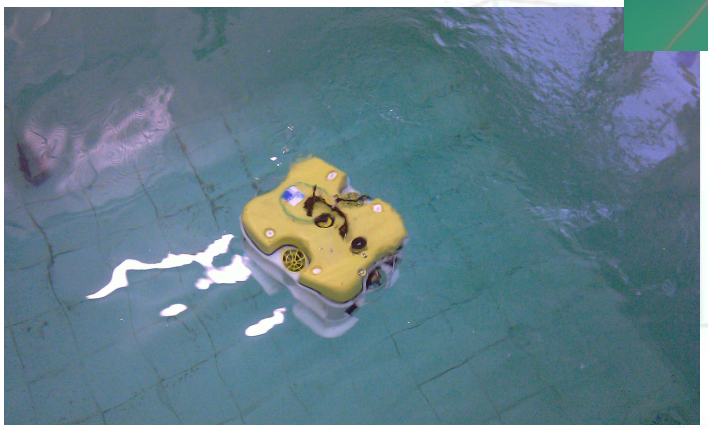


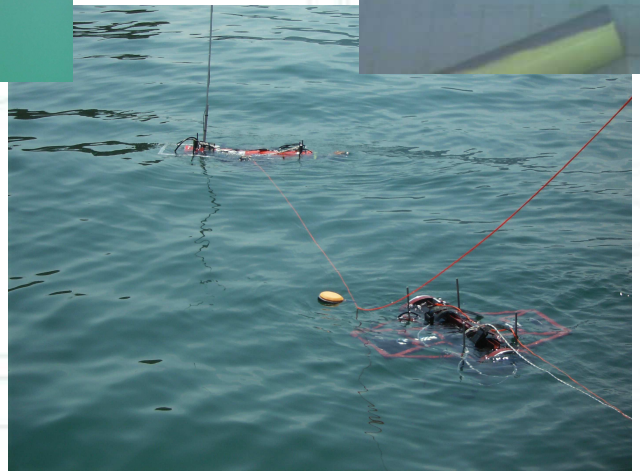
Principaux robots et concours









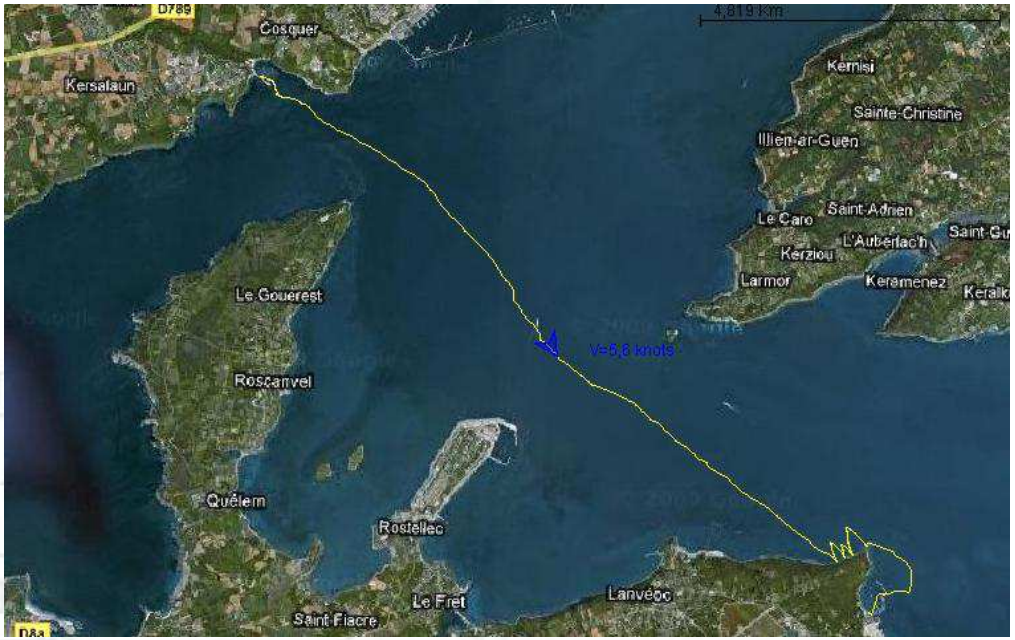


Principaux robots et concours

- Robots voiliers autonomes
  - Traversée de la rade
  - Challenge Microtransat
  - VAIMOS (partenariat Ifremer)
  - Optimist

Principaux robots et concours

- Robots voiliers autonomes
  - Traversée de la rade



Principaux robots et concours

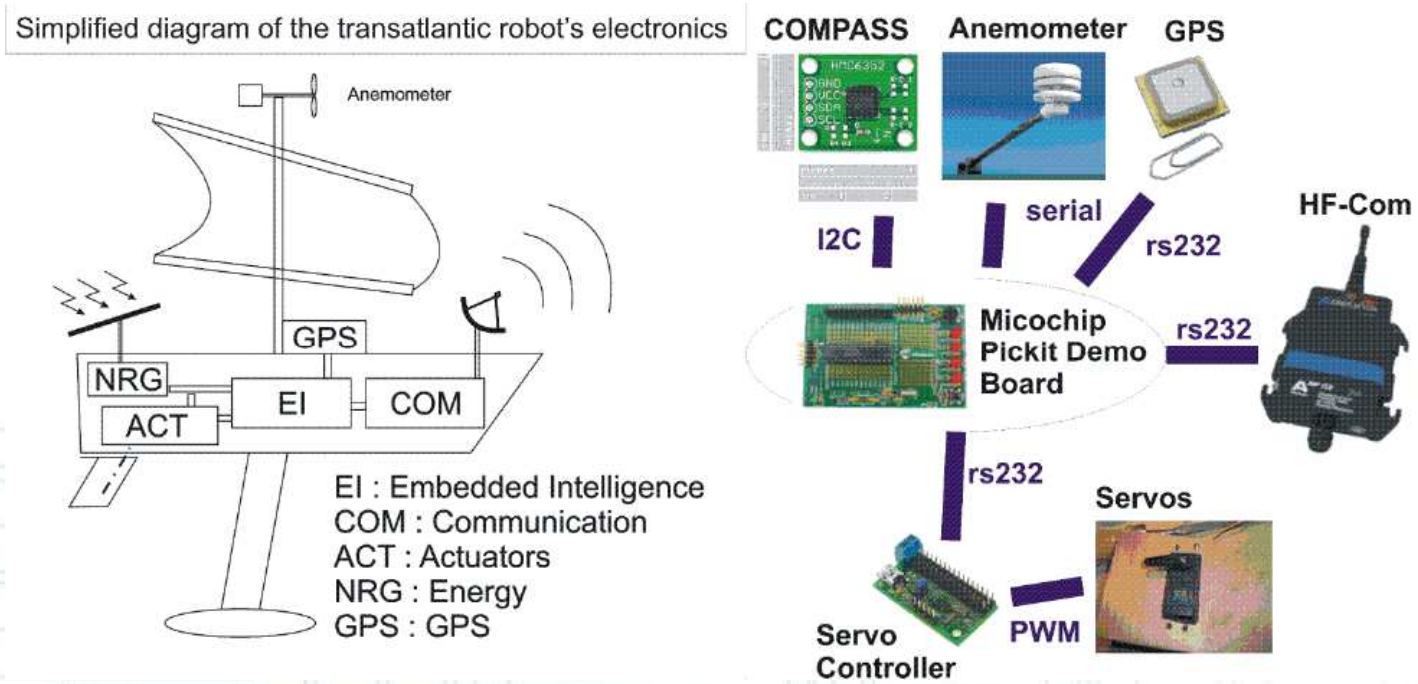
- Robots voiliers autonomes
  - Challenge Microtransat :

    Course de traversée transatlantique pour voiliers autonomes

    Chaque bateau doit donner sa position toutes les 24h

Principaux robots et concours

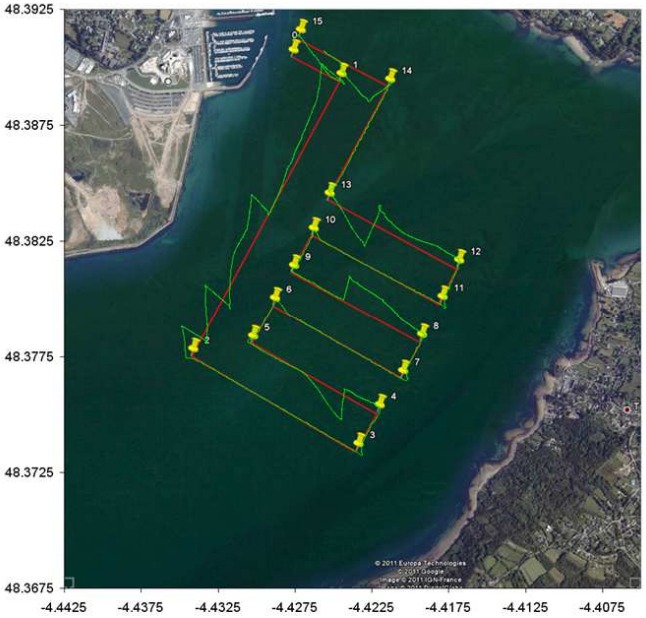
- Robots voiliers autonomes
  - Principe de leur électronique

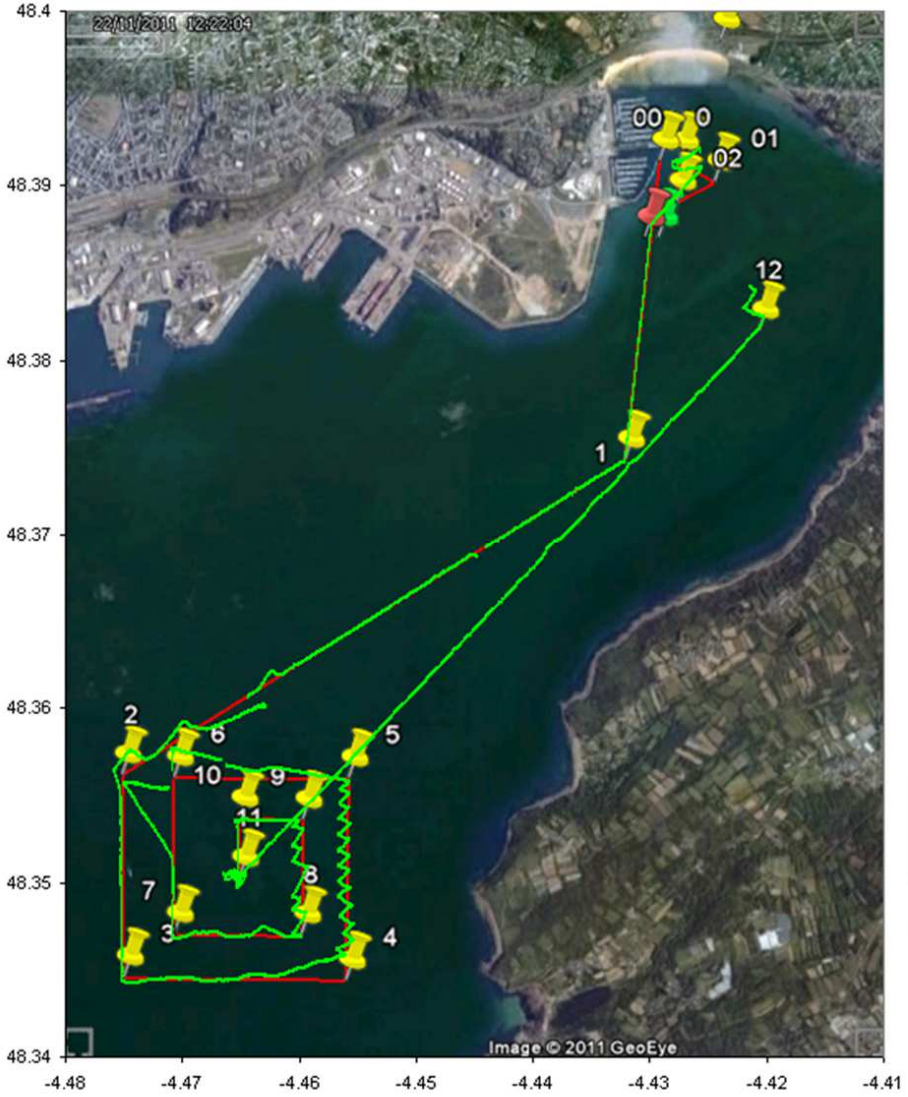


Principaux robots et concours

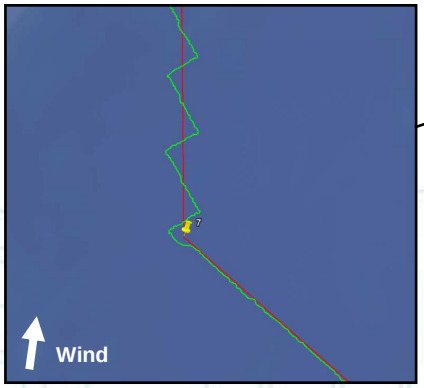
- Robots voiliers autonomes
  - VAIMOS

Principaux robots et concours





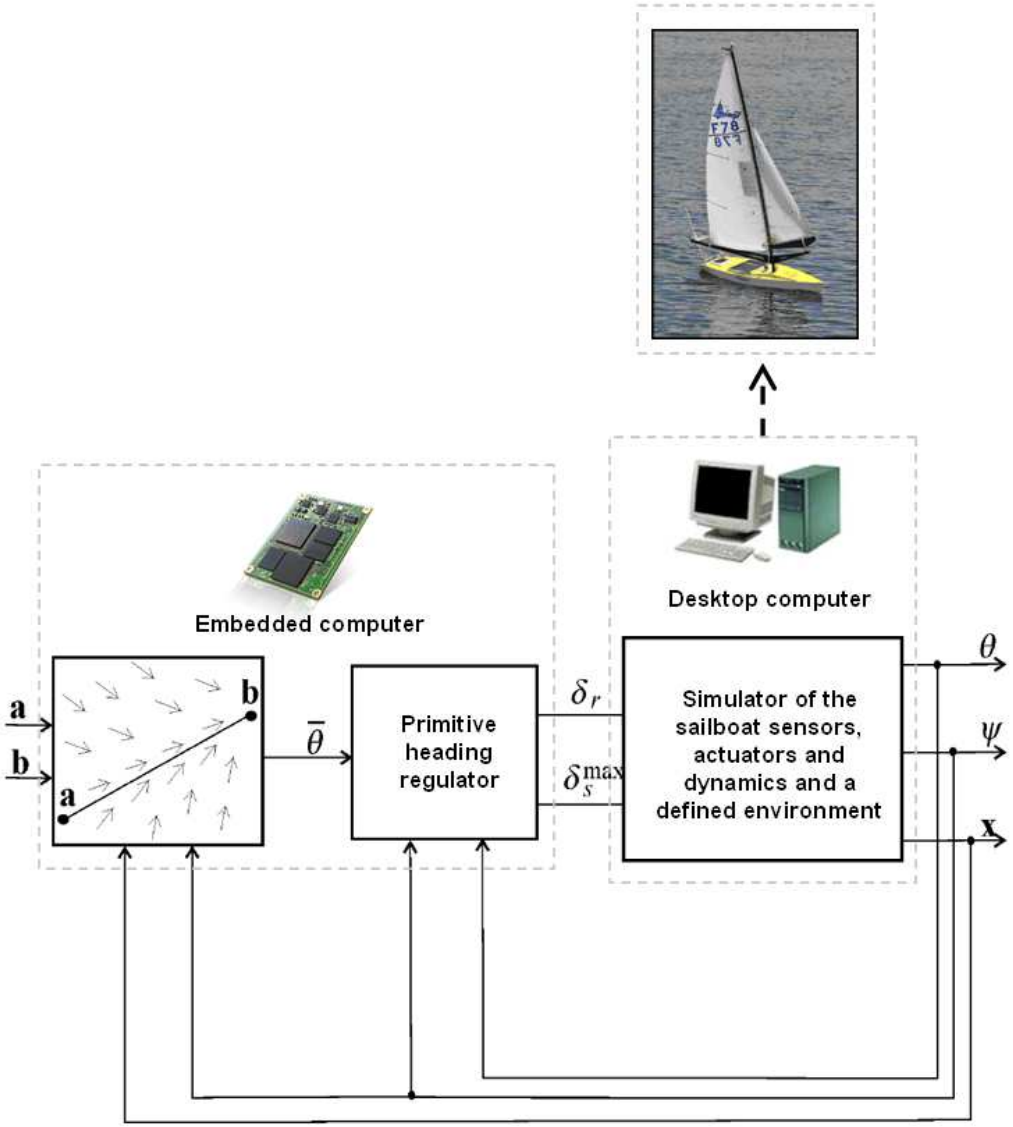
Principaux robots et concours

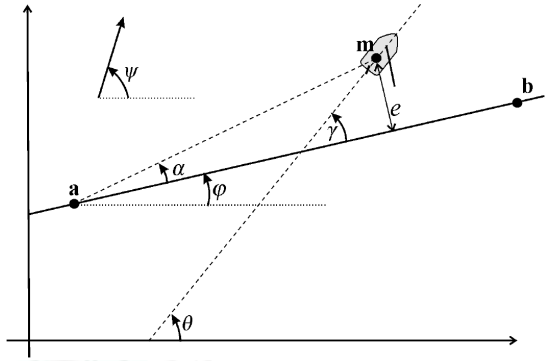


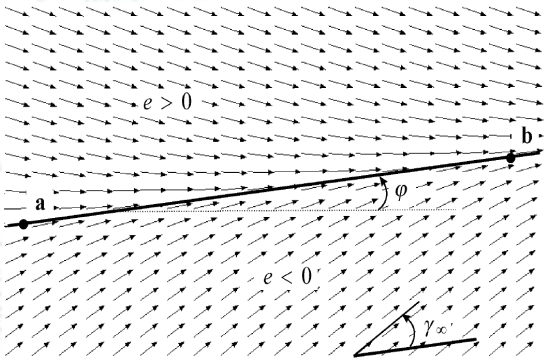
Détail d'un passage de stratégie en remontée au près à une stratégie de suivi direct de la ligne, décidé par le robot

Trajectoire Brest-Douarnenez voulue (lignes rouges formées par les waypoints jaunes) et effectuée (vert)

Principaux robots et concours







$$\delta_g = \delta_{g\max}.(\lambda \sin\gamma + (1-\lambda) * \mathrm{sign}(e))$$

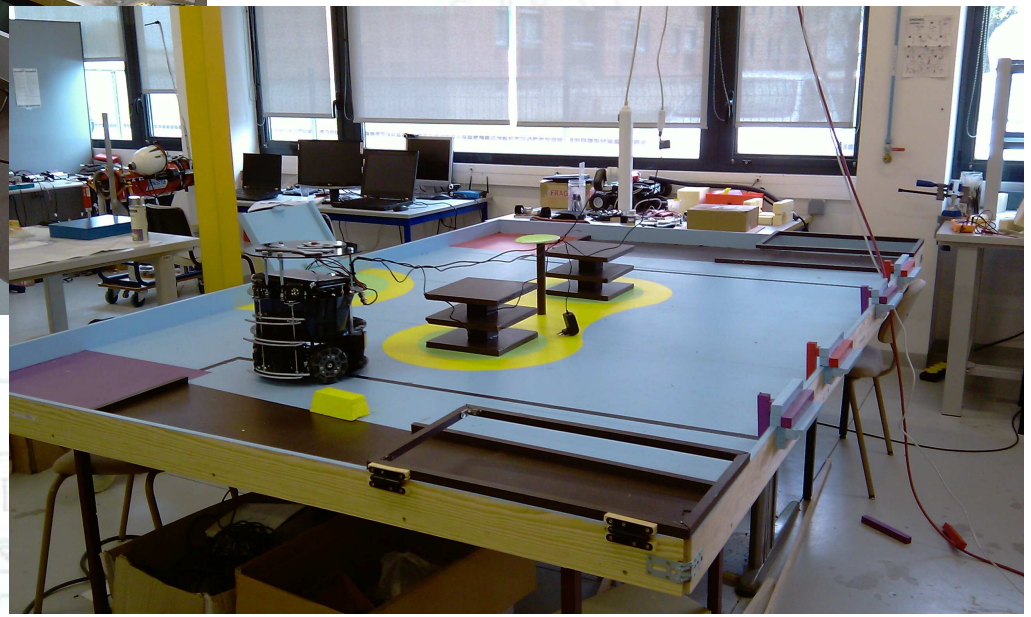
Formule de réglage du gouvernail en mode de suivi direct de ligne

Principaux robots et concours

- Robots voiliers autonomes
  - Optimist

Principaux robots et concours

- Coupe de France de robotique



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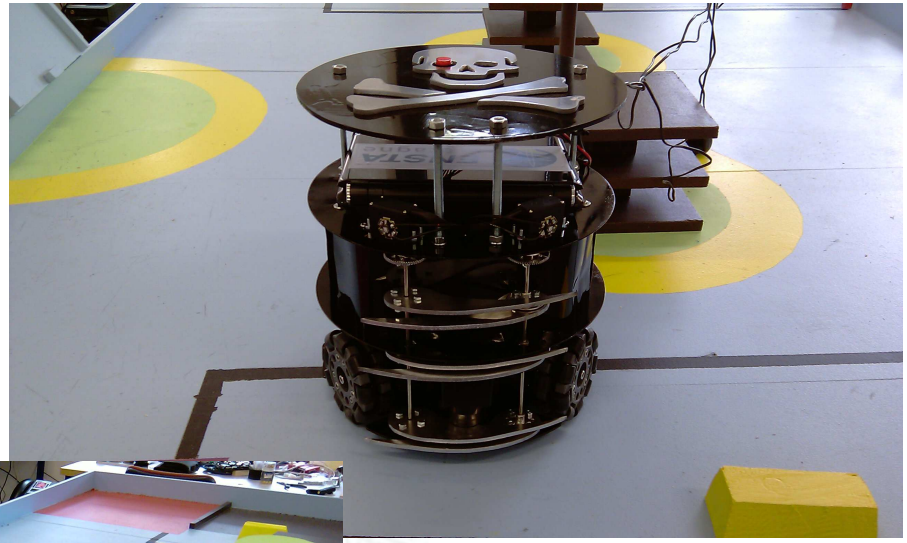

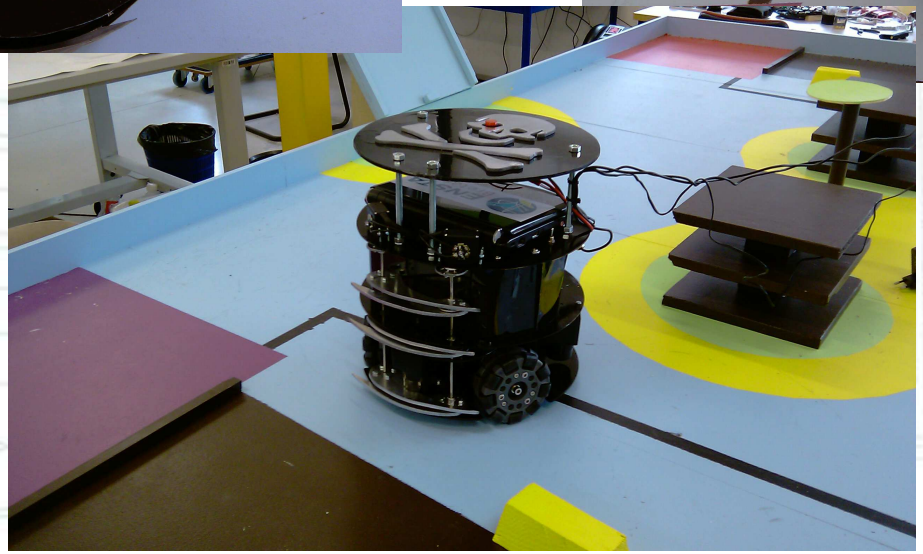

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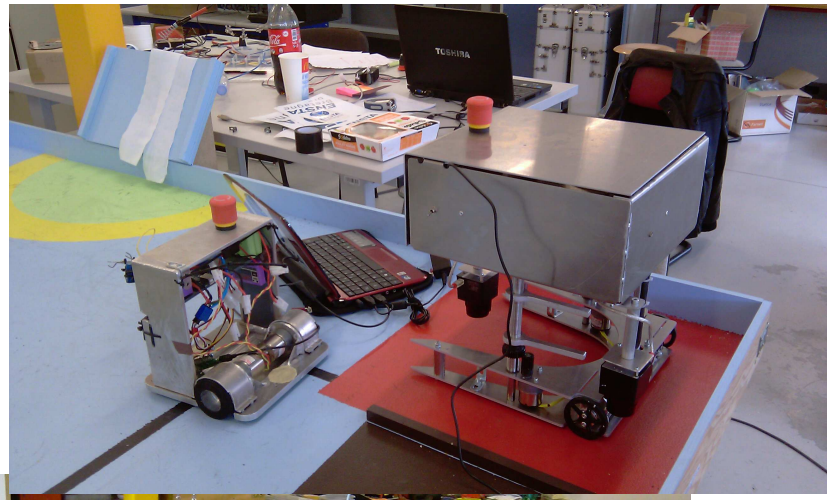

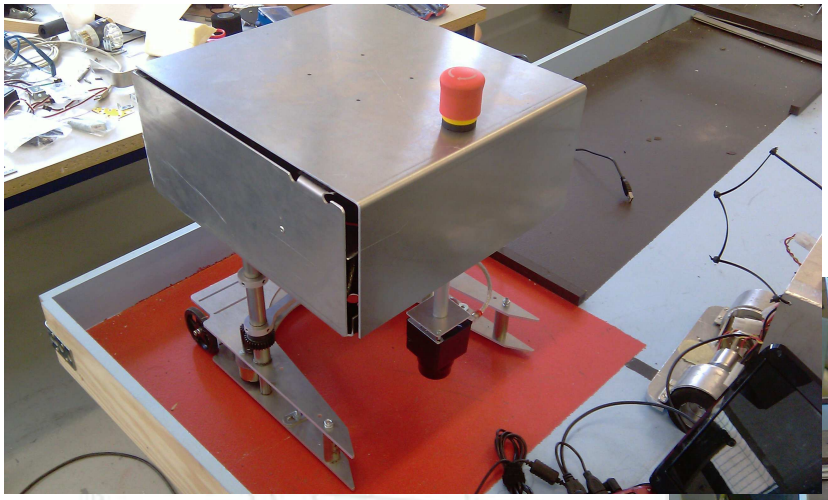

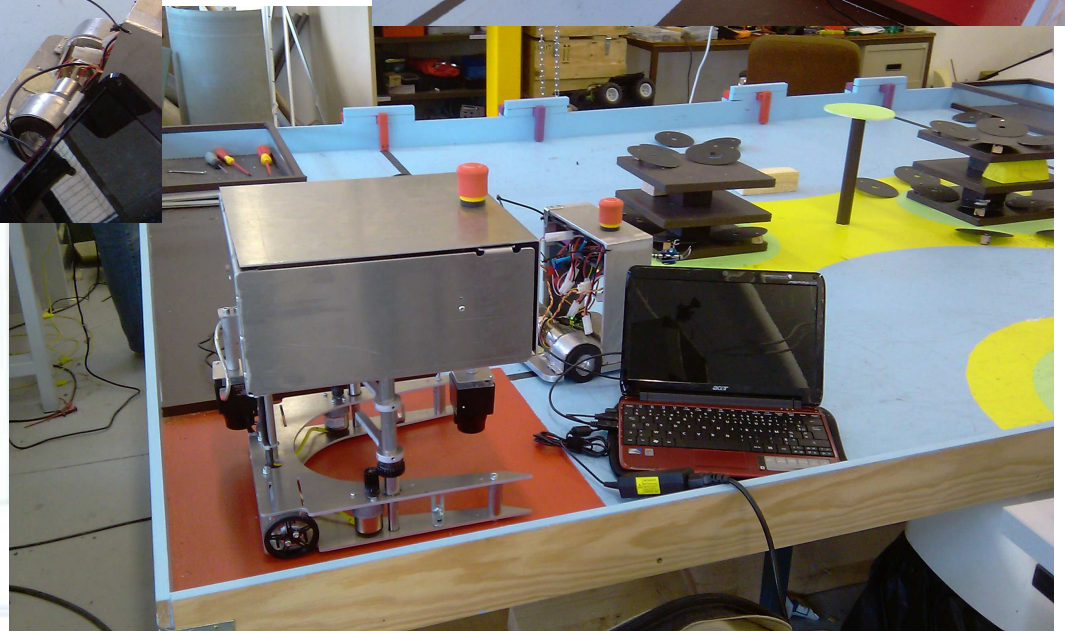

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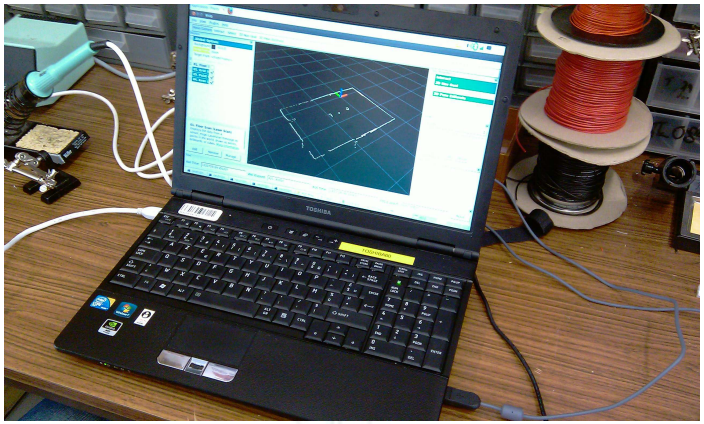
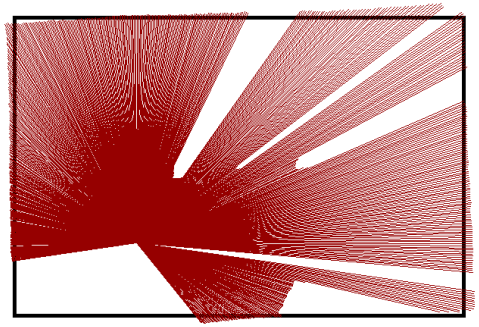
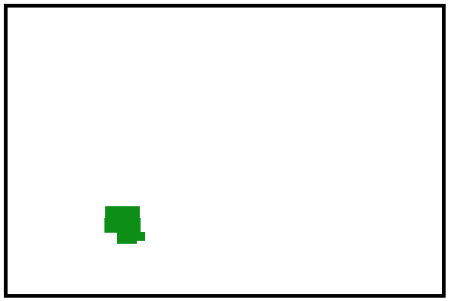
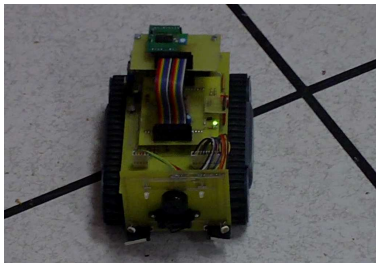
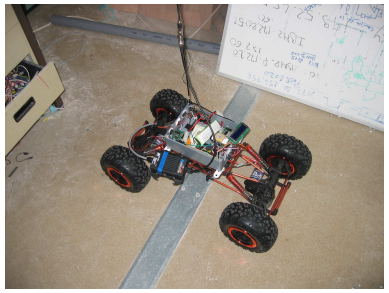
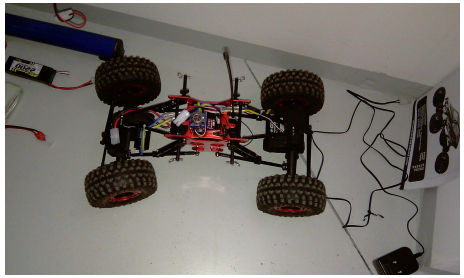


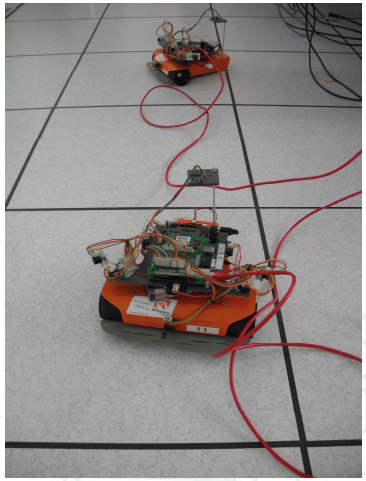


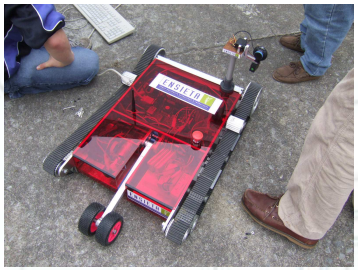


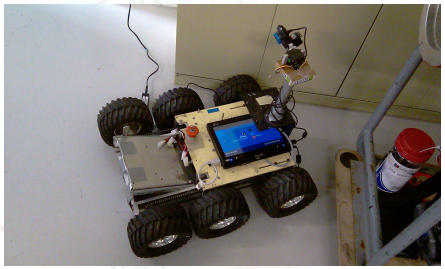




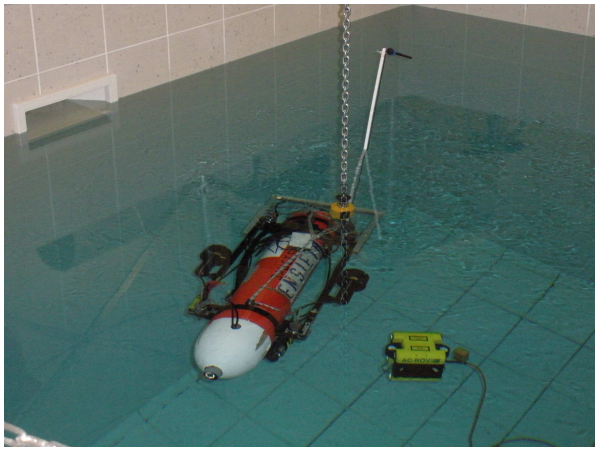


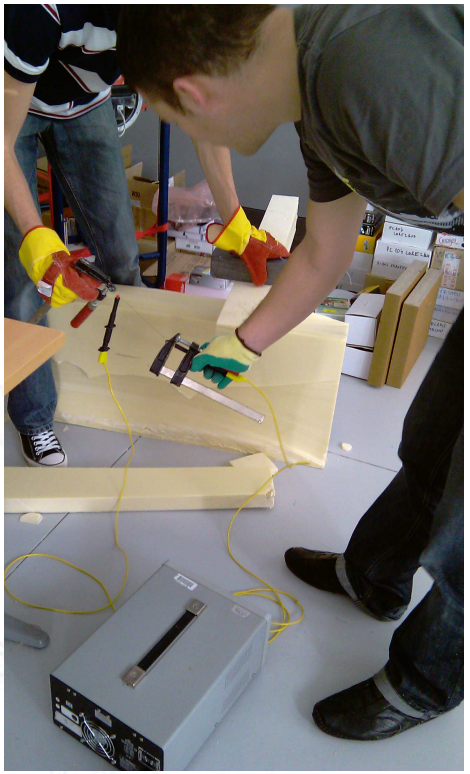






Autres robots





Organisation

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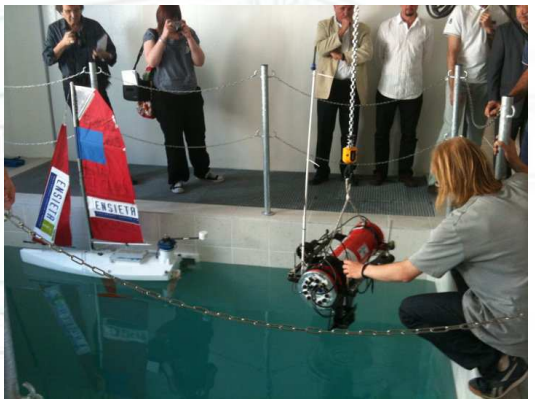
- Moyens
  - Budgets
    - 30000€ par la MRIS, partenariat Ifremer…
    - Budgets pour l'enseignement (TP, projets,…)
    - Prix gagnés aux concours et sponsors (club robotique)
  - Bâtiments réservés à la robotique
    - Bâtiment M : salle M 003 zone robotique, possibilité d'utiliser la piscine en M 014 pour des tests



Organisation

- Encadrement :
  - Personnels
    - Luc JAULIN (E 116, luc.jaulin@ensta-bretagne.fr)
    - Olivier REYNET (M 101, olivier.reynet@ensta-bretagne.fr)
    - Benoît ZERR (M 114, benoit.zerr@ensta-bretagne.fr)
    - Benoît CLEMENT (M 116, benoit.clement@ensta-bretagne.fr)
    - Yvon GALLOU (M 011, yvon.gallou@ensta-bretagne.fr)
    - Gilles LE MAILLOT (M 111, gilles.le_maillot@ensta-bretagne.fr)
  - Ingénieurs de recherche anciens élèves de l'école
    - Fabrice LE BARS (E 117, fabrice.le_bars@ensta-bretagne.fr)
    - Jan SLIWKA (E 117, jan.sliwka@ensta-bretagne.fr)
  - Doctorant ancien élève de l'école
    - Aymeric BETHENCOURT (M 113, aymeric.bethencourt@ensta-bretagne.fr)

Questions?

- Liens utiles pour plus d'informations
  - http://media.ensta-bretagne.fr/robotics/
  - http://www.ensta-bretagne.fr/Jaulin/club.html
  - http://www.youtube.com/user/ensietarobotics
  - http://www.facebook.com/pages/SAUCISSE/142805275731790?ref=sgm
- Contacts
  - robotique@webmail.ensta-bretagne.fr
  - luc.jaulin@ensta-bretagne.fr
  - fabrice.le_bars@ensta-bretagne.fr