

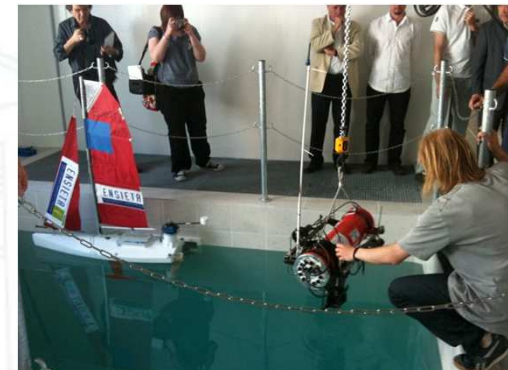
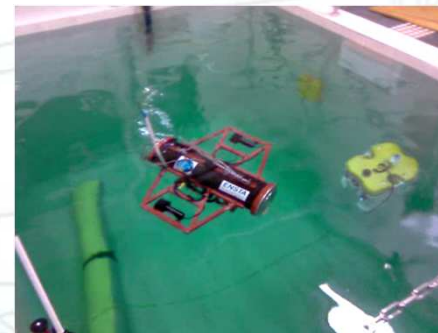
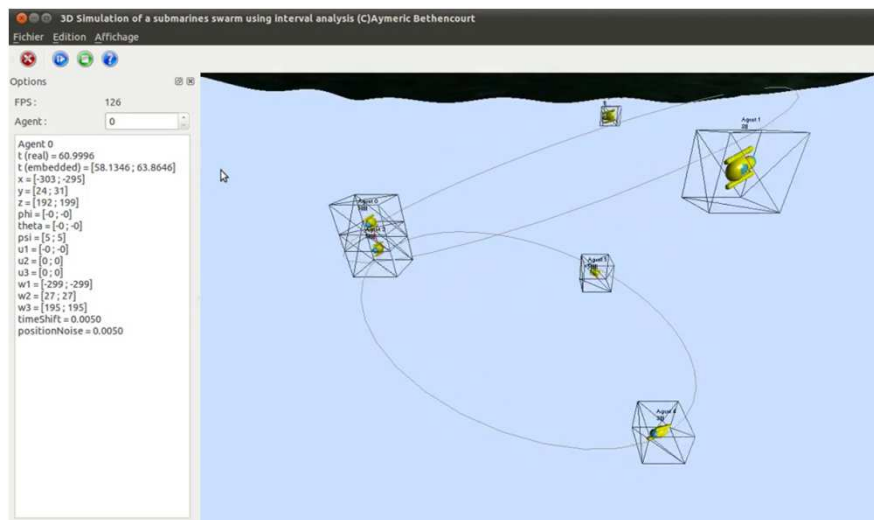
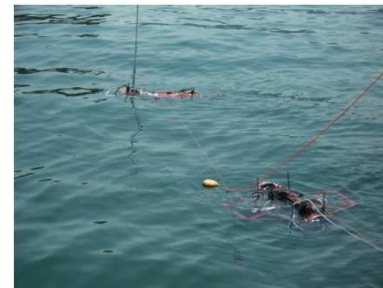


Robotics at ENSTA Bretagne

Fabrice LE BARS

Robotics at ENSTA Bretagne

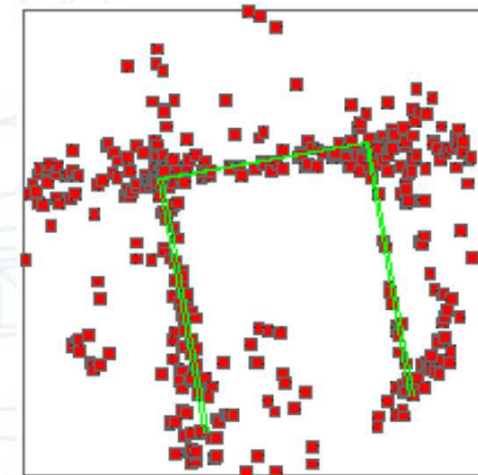
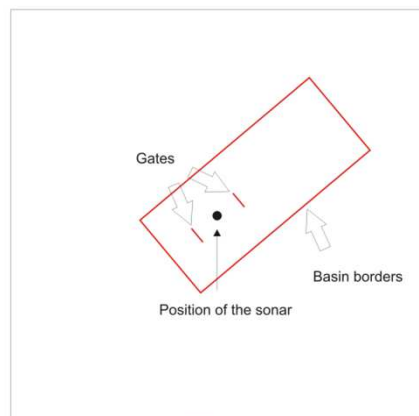
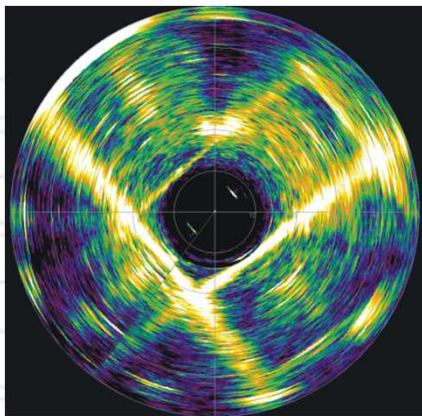
- Main research areas :
 - Autonomous marine and submarine robotics using interval methods
 - Swarm of robots



Robotics at ENSTA Bretagne

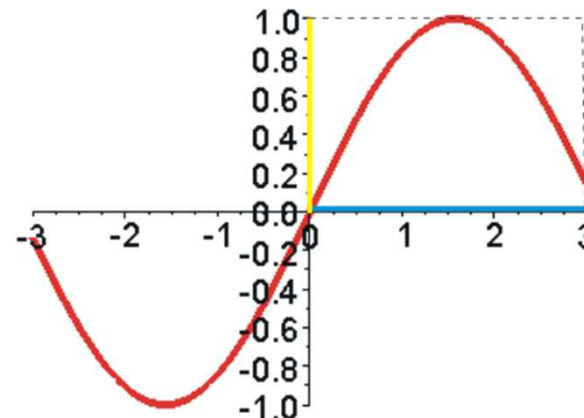
■ Facts

- **Autonomous robotics** rise new and **difficult problems**
- There are **few demonstrations of cheap autonomous robots** able to do survey, cartography, localization tasks, especially in marine and submarine environments
- **Current methods** : mainly **probabilistic**



Interval analysis

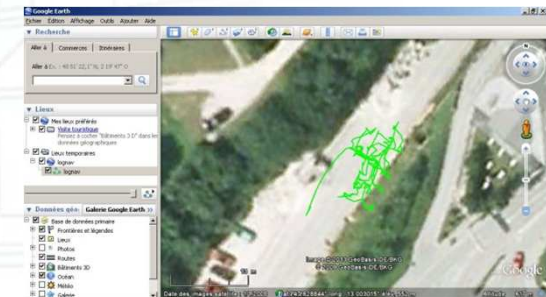
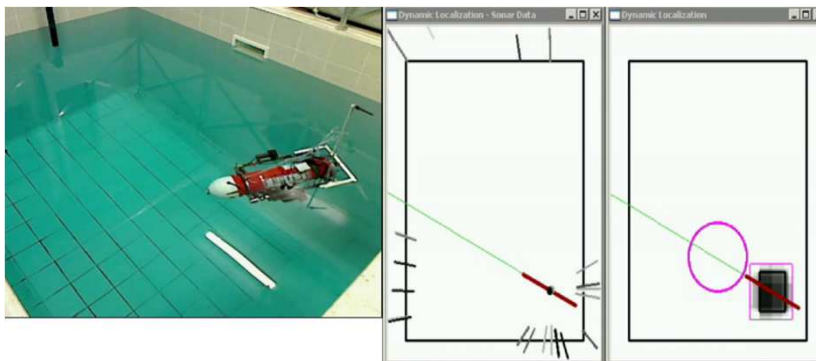
- $[-\infty, 2]$, $[-1, 4]$, $[-\infty, \infty]$ are examples of intervals
- Operations $\diamond \in \{+, -, *, /\}$
 - $[x^-, x^+] \diamond [y^-, y^+] =$ smallest interval containing the set of possible values for $x \diamond y$
 - $[-1, 4] + [2, 3] = [1, 7]$
 - $[-1, 4] * [2, 3] = [-3, 12]$
 - $[-1, 4] / [2, 3] = [-1/2, 2]$
- Multiplication by a number, intersection, union
 - $2[-1, 4] = [-2, 8]$
 - $[-1, 3] \cap [2, 4] = [2, 3]$
 - $[-1, 2] \sqcup [3, 4] = [-1, 4]$
- Image by a function
 - $\sin([0, \pi]) = [0, 1]$



Robotics at ENSTA Bretagne

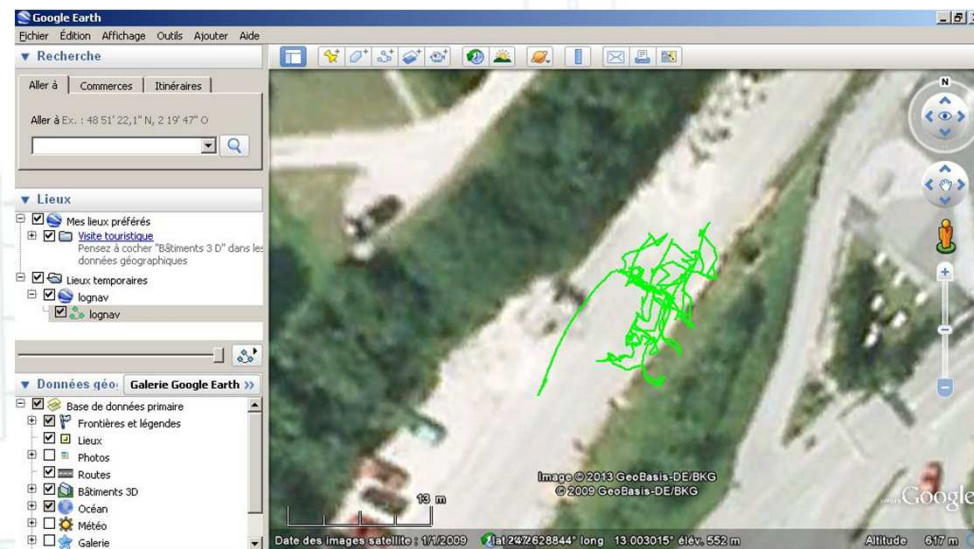
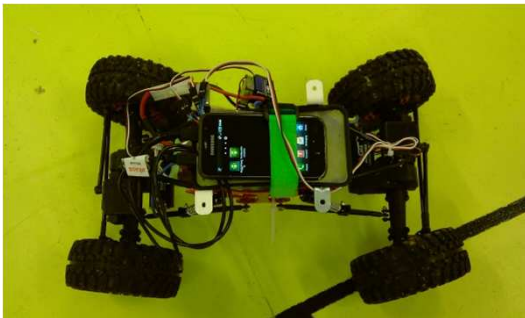
■ Goals

- Develop **observation, control methods** for **submarine, marine, ground and aerial robotics**
- Demonstrate the use of **interval methods** through new applications in **autonomous robotics**
- **Build real and convincing demonstrators**



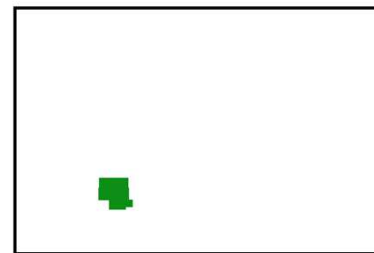
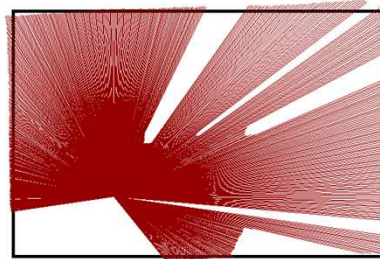
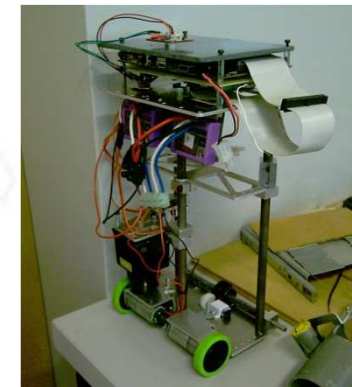
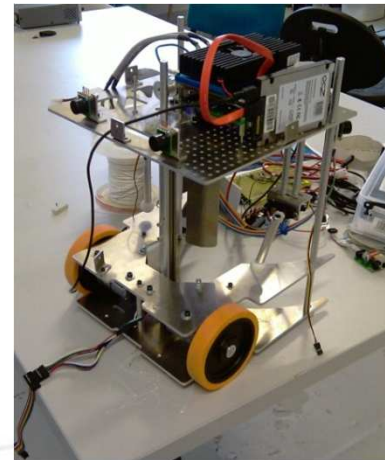
Ground robotics

- EURATHLON 2013
 - Task "Search and rescue in a smoke-filled underground structure"



Ground robotics

- Coupe de France de robotique
 - Involve **accurate** and **fast localization** methods



Ground robotics

- NAOs



Marine robotics

- Autonomous sailboats and motorboats
 - Crossing of Brest (FR) harbour
 - Microtransat challenge
 - VAIMOS
 - WRSC/IRSC 2013 at Brest



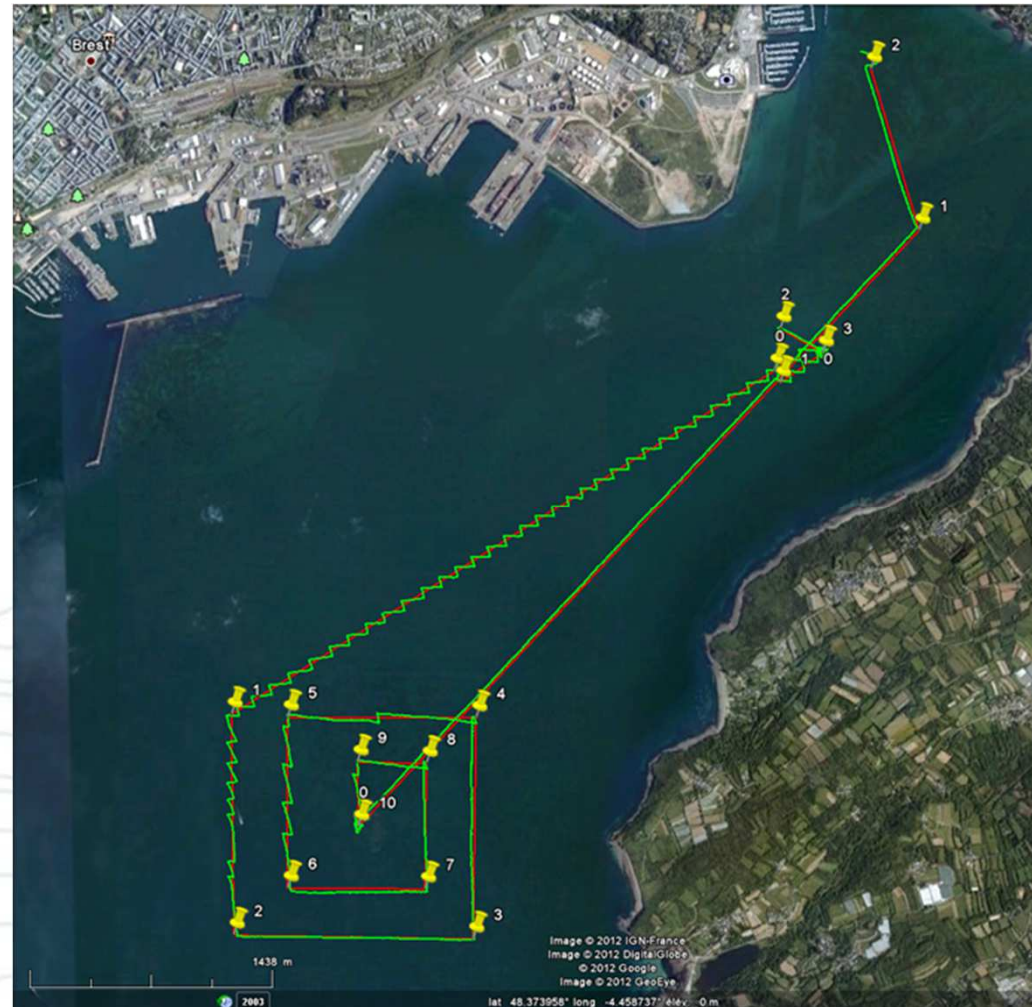
Marine robotics

- VAIMOS (Voilier Autonome Instrumenté de Mesures Océanographiques de Surface)

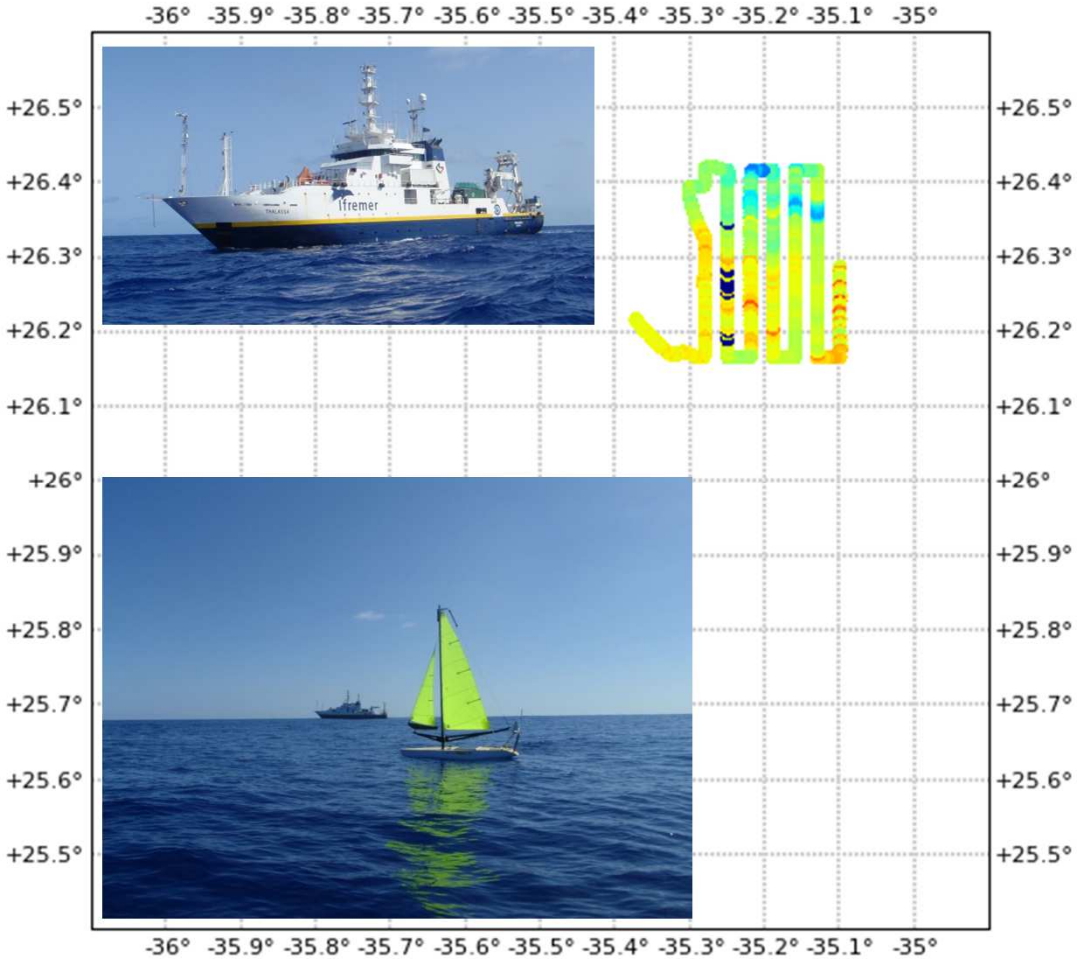
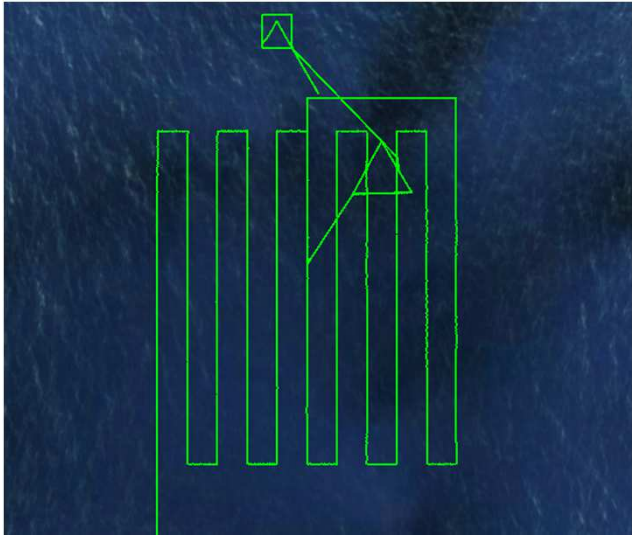


Marine robotics

- Tests in Brest harbour



Marine robotics

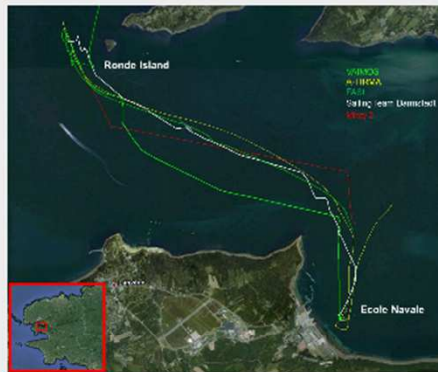


Marine robotics

- Organization of the WRSC/IRSC 2013 at Brest

Tracks of robots during some tasks

Endurance task between Ronde Island and Ecole Navale



Accuracy task : make a triangle trajectory as accurately as possible



Station task : stay at the same point during some time

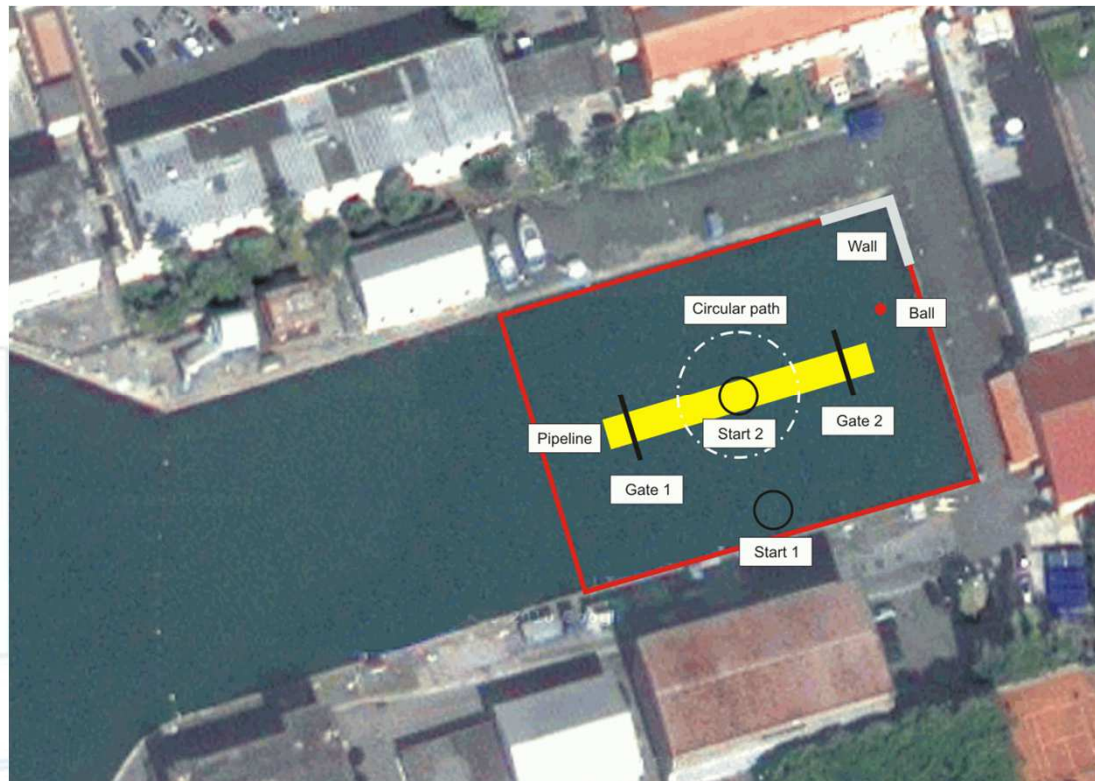
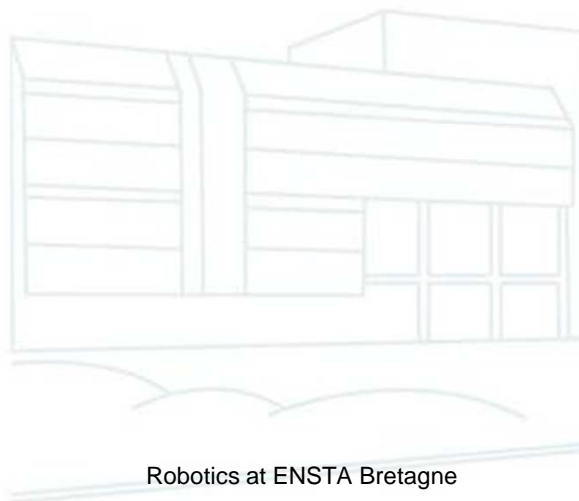


Obstacle avoidance task : go in the middle of a square and avoid a mobile obstacle



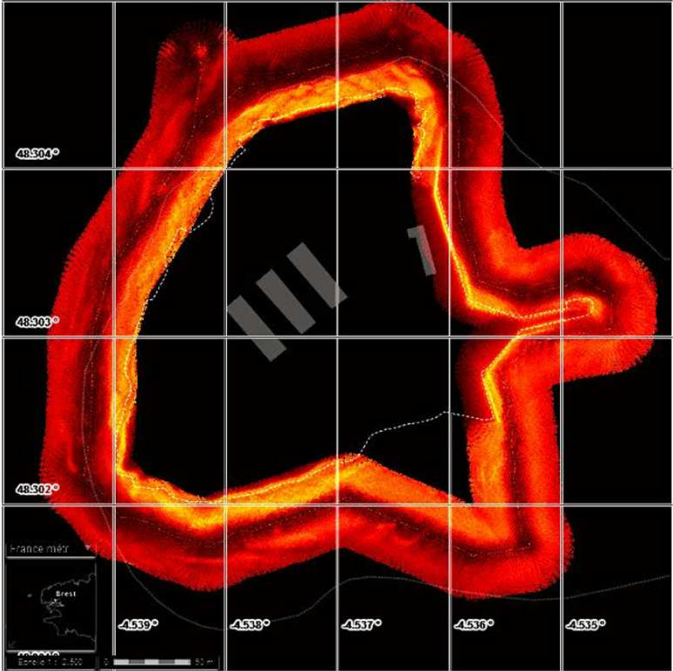
Underwater robotics

- SAUC-E (Student Autonomous Underwater Challenge - Europe)
 - Competition of autonomous submarine robots in a pool or harbour
 - Detection, localization tasks using sonar, camera...

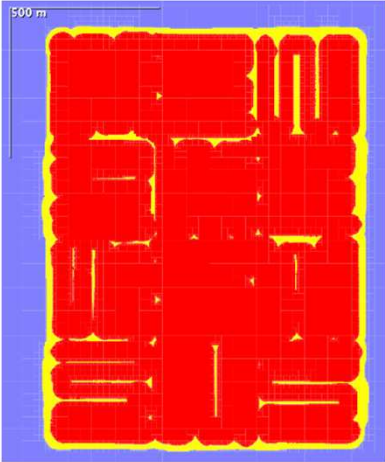


Underwater robotics

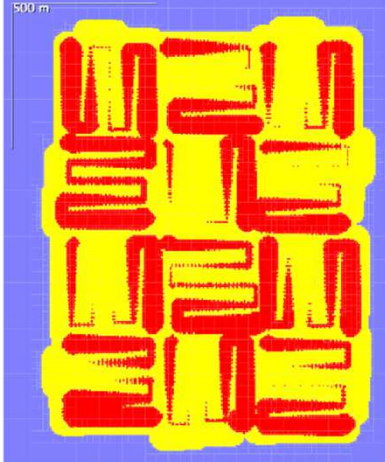
- Autonomous island tour and cartography



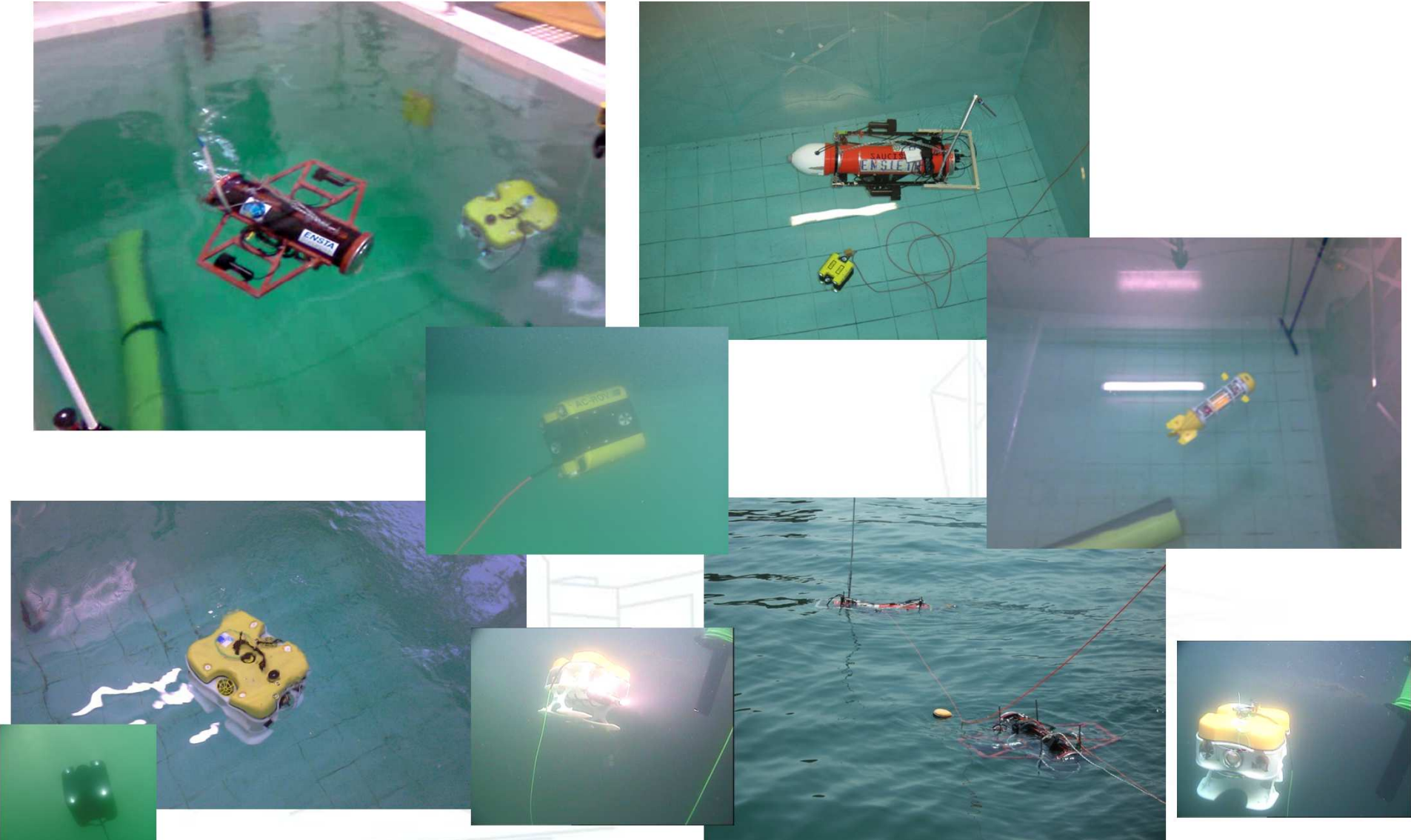
- With communication & ranging



- Without communication & ranging



Underwater robotics



Aerial robotics

- Quadrotor
 - Can be teleoperated or follow predefined GPS points
 - Can be used in conjunction to ground robots as a satellite around a building, to explore upstairs...
- Kite robot, motor glider
 - To retrieve energy
 - To survey quickly an area before launching other robots...



Questions?



■ Links

- <http://www.youtube.com/user/ensietarobotics>
- <http://www.facebook.com/pages/SAUCISSE/142805275731790?ref=sgm>
- <http://www.ensta-bretagne.fr/wrsc13/>

■ Contact

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