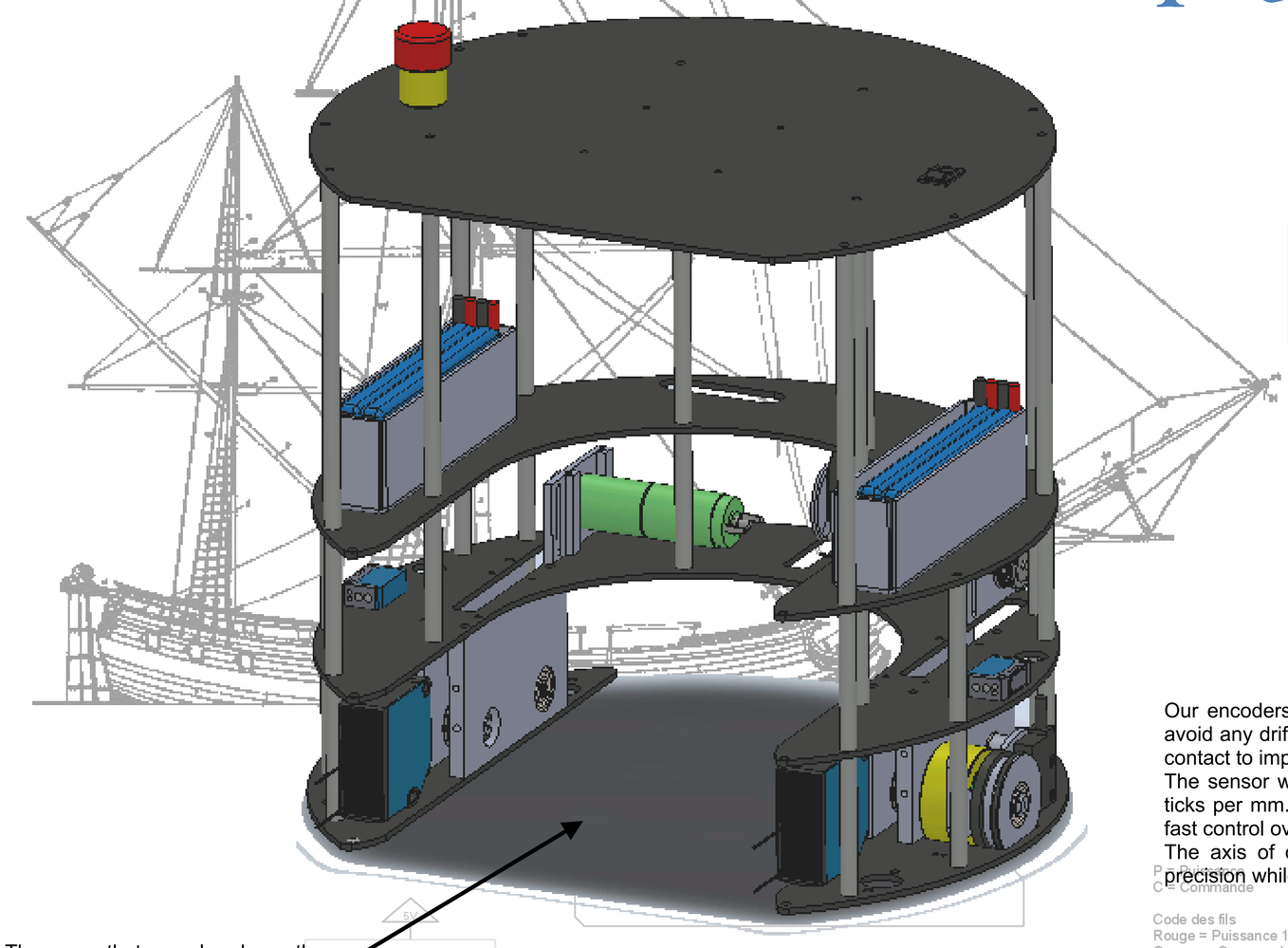
CVRA

Club Vaudois de Robotique Autonome

Swiss team

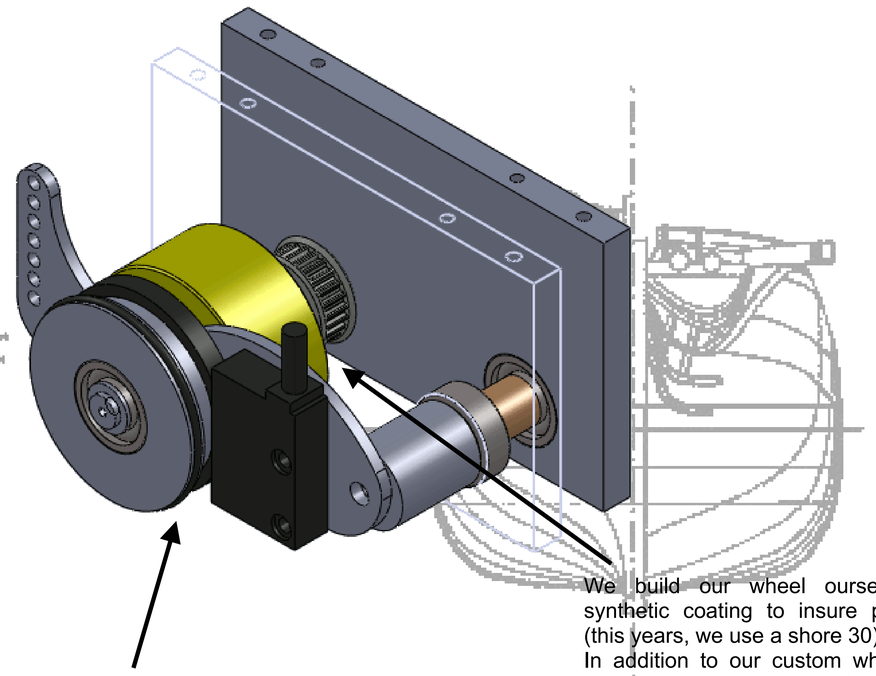
Presents : Black Pearl

Mechanical design:



The pawn that are already on the right case can pass trough our robot to avoid loosing time

The secret of our motion :



Our encoders are not on the motor but directly on the table to avoid any drifting error. This wheel is totally free and has a small contact to improve precision while turning.
The sensor we are using provide us with a resolution over 200 ticks per mm. This resolution easily allows us to do a good and fast control over our motion axis.
The axis of our encoders must be coaxial otherwise we loos precision while moving. That is why we use very tight tolerances.

We build our wheel ourselves using a synthetic coating to insure proper traction (this years, we use a shore 30).
In addition to our custom wheel, we try to avoid pinion and prefer strap because the backlash is less important, it is cheaper, easy to purchase and easier to use.

Control architecture :

We decide to design our own control system keeping in mind flexibility and performance. We wanted to be able to use our system in all projects we have in the club from Eurobot robot to a small milling machine or an autonomous submarine model.
Because these totally different projects require different hardware, the FPGA (Field Programmable Gate Array) is the only viable solution we find. This solution allows us to program some specific hardware (like counter for controlled axis) and the possibility to go further with our code using different hardware structure (µcontroller, DSP, µprocessor,...).
In addition, we work with modules. We design a module for every general task and can chose which of them to use depending the function we try to achieve.
For now, we have:

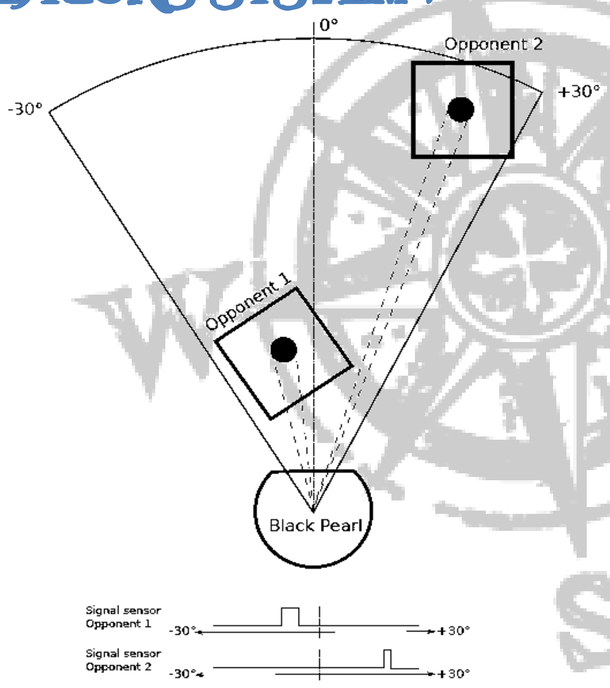
- One DC Brushless motor with encoder feedback
- Two DC motors with encoders feedback
- Eight digital inputs with adaptive threshold
- Eight powerful digital outputs open collector
- Eight analog inputs using a A/D with 8 channel and a serial SPI to the FPGA
- Six channel servo motors control with adaptive threshold TTL and servo power supply

In addition, we design a power management board. It supplies all tension we need and watch closely our lithium polymer battery to avoid any problem.

For example, this year we have two totally different robots.
The robot “Debra” (on another poster) need eight fully controlled axes, multiple IO and uses a computer for advance AI, vision system, beacon localization and calculate every trajectory avoiding the opponent.
The robot “Black Pearl” needs only two axes and a couple of IO. It did not require vision or advance calculation so we don’t need a computer and embedded everything we need on the FPGA softcore.
In both these example, all actuator and IO (except vision and beacon localization) are controlled by the FPGA. These two examples show that we can use the same control in two totally different ways without having to change the electronic. It offers us a flexibility that allows us to adapt our project to nearly any situation.

Robot pictures :

Beacons system :



It is not really a beacon system but more a collision avoidance system base upon a beacon on the opponent robot. This system is pretty simple and affordable. The key points are:

- We have a reflex sensor at the top of our robot which scan in front of the robot.
- The opponent robot has our beacon which is a simple reflective cylinder.

While the robot is in our trajectory, our sensor see the beacon. The size of the signal give us an estimation of the distance between us an the opponent. The “bigger” is the signal, the closer we are.
Every time we detect a possible collision, we avoid it by changing our path and stop if needed. By trying to change our path first, we reduce the risk of two robot stuck. If we need to stop, we try different path to liberate ourselves.

Strategy :

This time, we try a very unusual strategy. Because we have two robots, we decide that this one will be a Pirate.
Our robot is not able to build tower but is design to steal them. To do so, we emphasis the motion and use a simple system to avoid the opponent. As a result, our robot is fast and have a high precision while moving on the table.
We will score a little by our own and expect the other robot to build high value tower for us.

As every Corsair, we know that our strategy may be discussed and that if somebody stop us, we will be hang ;-)

Members and Tasks :

Boris Pillionnel *(Black Pearl)*
Mechanical engineer, Robot design

Cédric Debétaz *(Black Pearl)*
Programmer engineer, collision avoidance system

Olivier Wenger *(Black Pearl)*
Programmer engineer, Strategy

Rouven Althaus *(Black Pearl)*
Programmer and electronic engineer, Motion and FPGA modules

Antoine Albertelli *(Debra)*
Programmer engineer, Motion

Florian Glardon *(Debra)*
Programmer engineer, Strategy

Joseph Lemaître *(Debra)*
Programmer engineer, Vision

Michael Jeanneret *(Debra)*
Electronic engineer, FPGA IO

Patrick Eugster *(Debra)*
Electronic engineer, Beacon

Romain Bersier *(Debra)*
Mechanical engineer, Robot design

Thierry Prêtre *(Debra)*
Sponsoring, Vision programmer

Vincent Kern
Poster design (from USA) and troublemaker ,-)

All our member are needed to chose the concept of our robot

As a team, all member help on every task to share our knowledge.

Sponsors :

Special thank to all our sponsor! They make our passion a reality.