

TIRREX: Humanoid Robotics Axis

RENOIR: fREnch New HumanOld Robot



RENOIR: a shared platform for the French Community

Overview

- Lessons learned from ROBOTEX
- Spirit of TIRREX
- Does that fit the GT-7 needs ?
- Structure of the humanoid robotics axis
- Specifying the robot
- How can you participate ?
- The challenges
- In the meantime...

Lessons Learned from ROBOTEX (1/2)

- Roméo was not a success: none of the 3 inside the network are currently much in use.
- iCub was well used for social interaction, it was more difficult to use for whole body manipulation and walking.
- HRP-4 is more successful. It is still in use, and led to many nice scientific papers. It however has its own set of problems: light, and on board computing is difficult.
- HRP-2 is nice. But it is based on old set of technologies and the update of the operating system has to be done by ourselves.



Lessons Learned from ROBOTEX (2/2)

- Humanoid robots are expensive
 - Roméo 250 K euros
 - HRP-2 500 K euros
 - TALOS 1M euros
- If they are fragile they are difficult to use and to maintain (ex. iCub and to some extent TALOS)
- Humanoid robotics needs people from mechanics, control, perception, software with a very high level of knowledge.
- Collaboration is needed because few teams have all the competences
 - For instance the iCub network was appreciated by F. Bailly (GIPSA Lab.)
- Software cost development is very high
- Classical French format of PhD make difficult to build up a good experimental feeling (having experimented people are important)

Spirit of TIRREX

Technological Infrastructure for Robotics Research of Excellence

- Goal: One outstanding platform shared by the community
- Support of the robotics community
- Made available through an auditable system
- Software development costs are not covered
- Human Resources and the buildings have to be provided by the host institutions
- Apart equipment no partners receive money
- There is a technical manager (G. Saurel) and an Axis Head (O. Stasse)

Does that fill the GT-7 needs ?

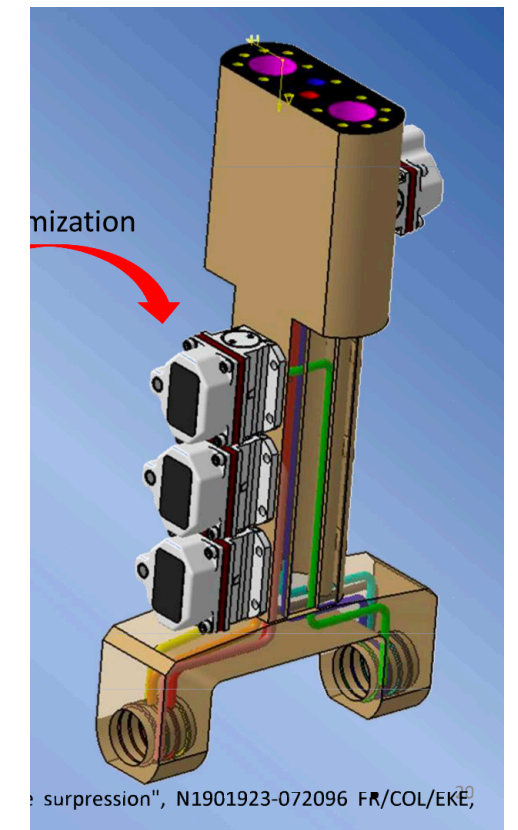
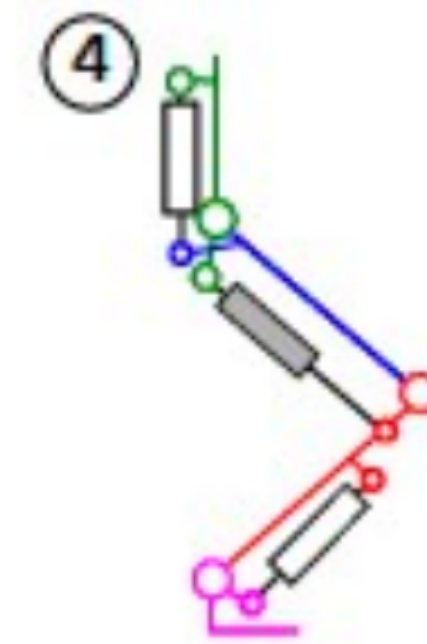
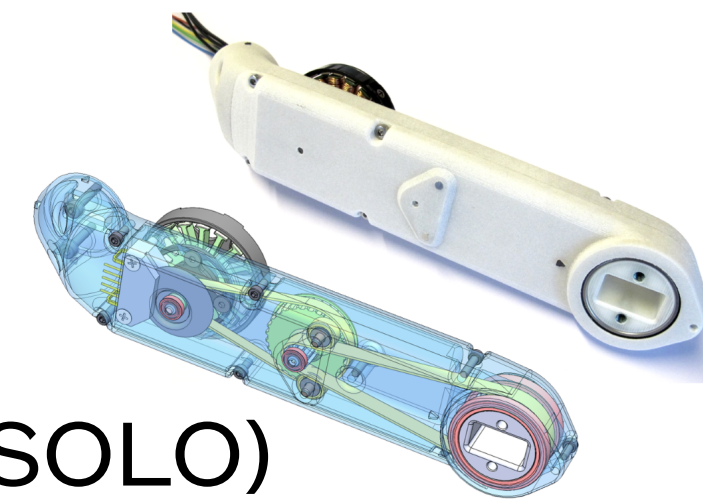
- Some of the robots realized during ROBOTEX will not be supported:

- iCub Robots
- HRP-4
- Hydroid - Tino

NO!

- There is a strong need to master mechatronic and design new actuators:

- Bi articular linear actuator
- Electro-hydrostatic actuator
- Small, highly dynamic, and robust legged robots (RHOBAN, SOLO)
- Only fulfilled through the prototyping axis of TIRREX



- Software exchanges and usability on humanoid robots is of **primary importance**. It is often a reason for failure. There will be a limited support for software in the project.

Structure of the Humanoid Robotics axis

- Major Partners:
 - Mechatronics Design: IBISC, INRIA Rhône-Alpes, LAAS, LS2N
 - Control: INRIA Rhône-Alpes, LAAS, L2S, LORIA, LS2N, INRIA Paris
 - Motion-Planning: INRIA Rhône-Alpes, LAAS, LORIA
 - Estimation, Identification: L2S, LISSI, LS2N
 - Machine Learning: ISIR, LORIA, LAAS
 - Perception: IRISA
- Partners of second rank:
 - Manipulation: LIRMM, UCA

Specifying the next humanoid robot (1/2)

- Committee to specify the robot:
 - As robust as HRP-2
 - Skeleton
 - Lighter than TALOS
 - New actuators:
 - Linear actuator ?
 - Parallel ?
 - Direct Drive ?
 - The most important is to have a USEFUL robot at the hand.
 - Better Power Electronics.
 - Making the robot such that it is easy to change the head (perception), the feet or the hands.
 - Choosing the communication bus such that a skin could be possible

How can you participate ?

- Because the platform will be available through an invoice system you can include the cost in your projects (ANR, European project)
- It can be done through participation to the committees (for the partners who have already expressed their interest)
- The access to the platform is not closed to external partners
- BUT there will be a committee to select projects if they are too many...
- You can participate by developing software needed for the platform:
 - Perception: ViSP (maintained by IRISA), your SLAM system
 - Control: SoT (maintained by LAAS), testing other controls (mc_rtc, OpenSoT), your system
 - Motion planning: HPP (maintained by LAAS), your motion planning system
 - Dynamical library: Pinocchio (maintained by INRIA Paris and partly by LAAS), RBDyn, your library
 - Trajectory optimization: Crocodyl (maintained by LAAS), TrajOpt (ROS-industrial), your library

The challenges

- Make this collaboration successful (fixing what went wrong and keeping what worked)
- Build the projects to make the project alive
- Make the software more accessible
 - Huge improvements were made for the following softwares
 - @LAAS (pinocchio, crocodyl, and to some extent SoT)
 - @LIRMM mc_rtc
 - Work with the other teams to facilitate their research
 - User feedback
 - Simulations:
- Simplify how experiments can be done

In the mean time...

- In the eight years project we will not have the new robot before year 3
- ... but we still can work together
- TALOS-LAAS will be made available (through the invoice system if needed)
- HRP-4 and TALOS-LORIA are available for scientific collaboration (NOT specific to TIRREX) but upon the acceptance of the research teams.
- We can start exchanging on the software through simulations

Torque control on TALOS

- It is possible to have a direct access to the robot motors. Available in simulation through binaries.
- Example: DDP over an horizon with torque limits [Ramuzat, ECC, 2020]
- Recent work by N. Ramuzat provides an example of whole body control using torques based on Gazebo. Not yet available through binaries.
- It is also possible to send joint torque, PAL is proposing a system which compensates for the actuators specific. [Demonstration for HCERES]

<https://www.youtube.com/watch?v=g8-LZHWIaXk>

<https://youtu.be/akK1E0nzbM?list=TLPQMjYwNjIwMjBK3aUIdkQcYQ>

Walking with TALOS

- You can use the online walking pattern generator provided by PAL-Robotics [Maroger, IROS, 2020 submitted]
- Use the LAAS pattern generator [Naveau, RA-L 2017] Walking straight OK, still a problem while turning. Available through binaries.
- Stabilizer of [Caron, ICRA 2019] implemented partially in the SoT. Available through binaries.
 - Working nicely on the spot
 - Still not sufficient for walking

Conclusions

If accepted...

- It is a platform for the community
- It will be located at LAAS but available to all partners
- It will be specified by the community
- Can be quoted and specified for your French and European projects
- There will be software support BUT
 - Some tools will be supported by Gepetto & LAAS
 - Other will imply your or external collaboration
 - ROS (2) is a good candidate to exchange/compare softwares