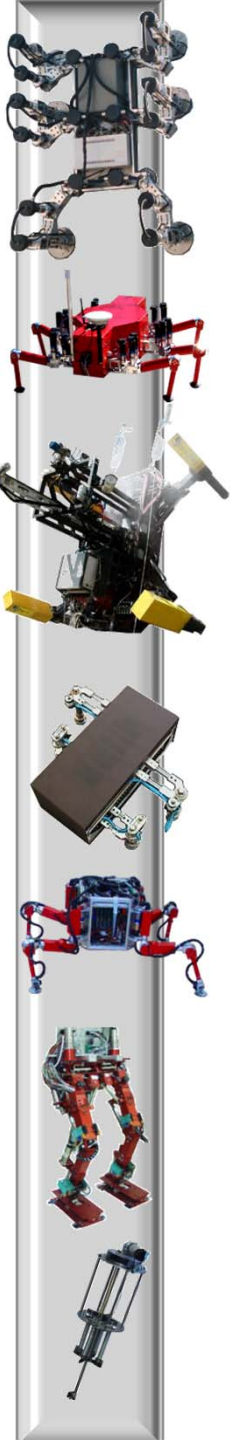

RISE 2015

8th IARP Workshop on Robotics for Risky Environments

CAR
CENTRE FOR AUTOMATION AND ROBOTICS

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

POLITÉCNICA

Hexapod Robot for Humanitarian Demining

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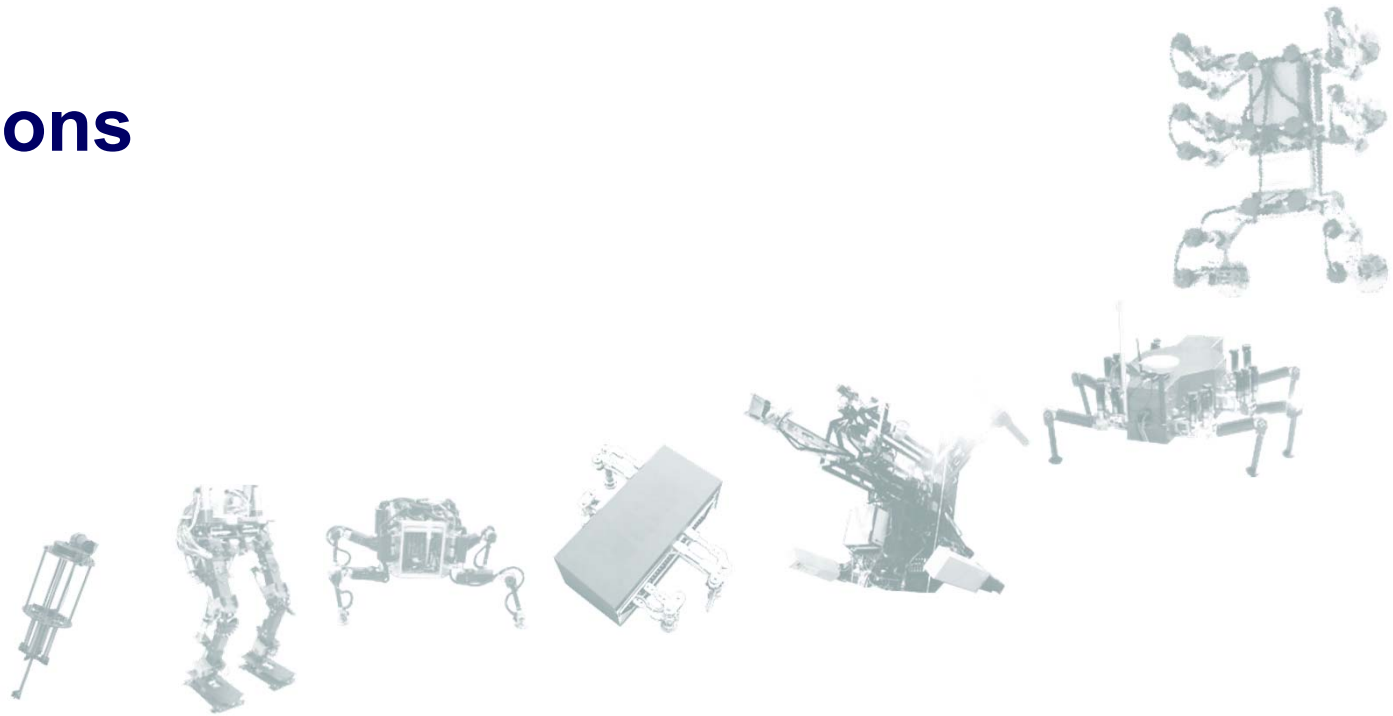
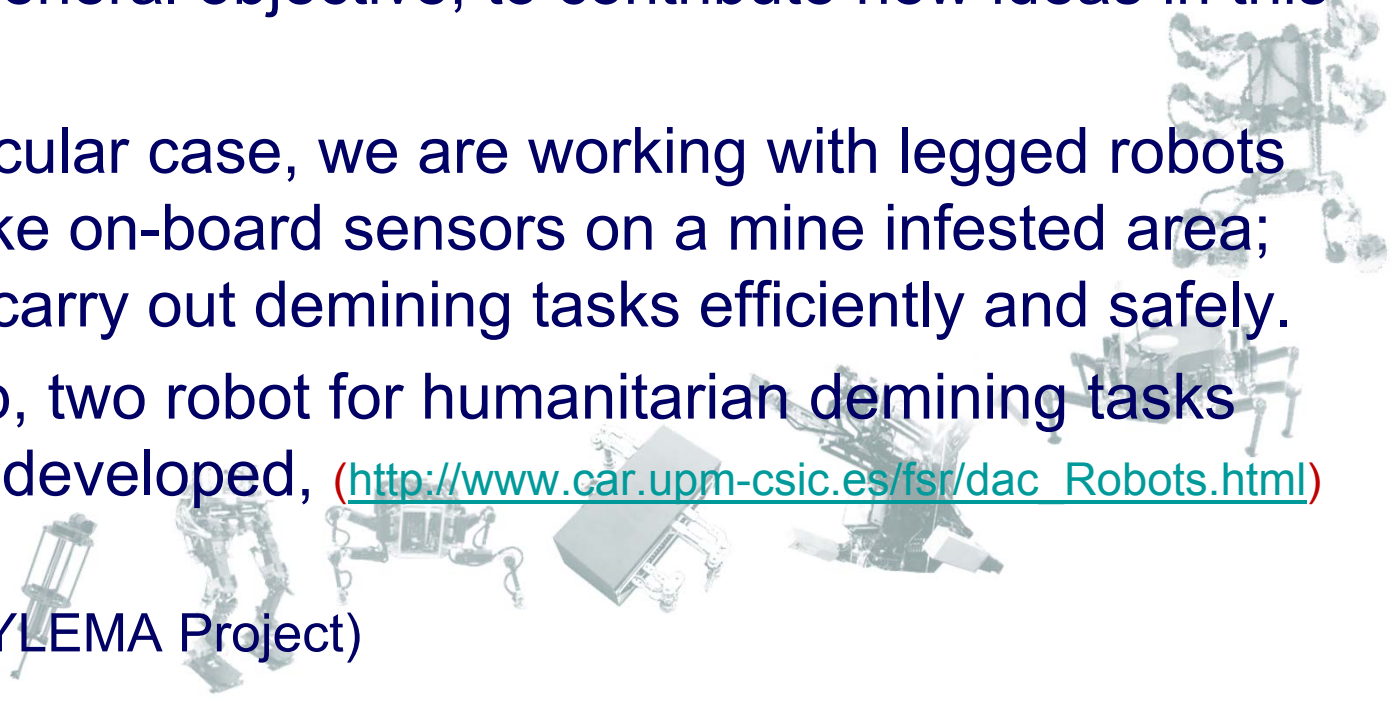
Outline of Presentation

- Introduction
- The SILO6 walking robot
- Description of the hexapod robot
- Experimental tests
- Conclusions



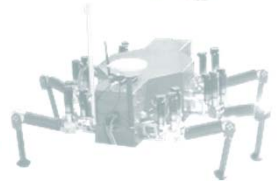
Introduction

- As is well known by people that work in humanitarian demining, among other, the fields infested by landmines is a serious problem with remarkable political, social and economics dimensions.
- Various humanitarian projects have been developed to help to this problem, and other are being developed with the same general objective, to contribute new ideas in this cause.
- In our particular case, we are working with legged robots that can take on-board sensors on a mine infested area; which can carry out demining tasks efficiently and safely.
- In CSIC lab, two robot for humanitarian demining tasks have been developed, (http://www.car.upm-csic.es/fsr/dac_Robots.html)
  - RIMHO
  - SILO6 (DYLEMA Project)

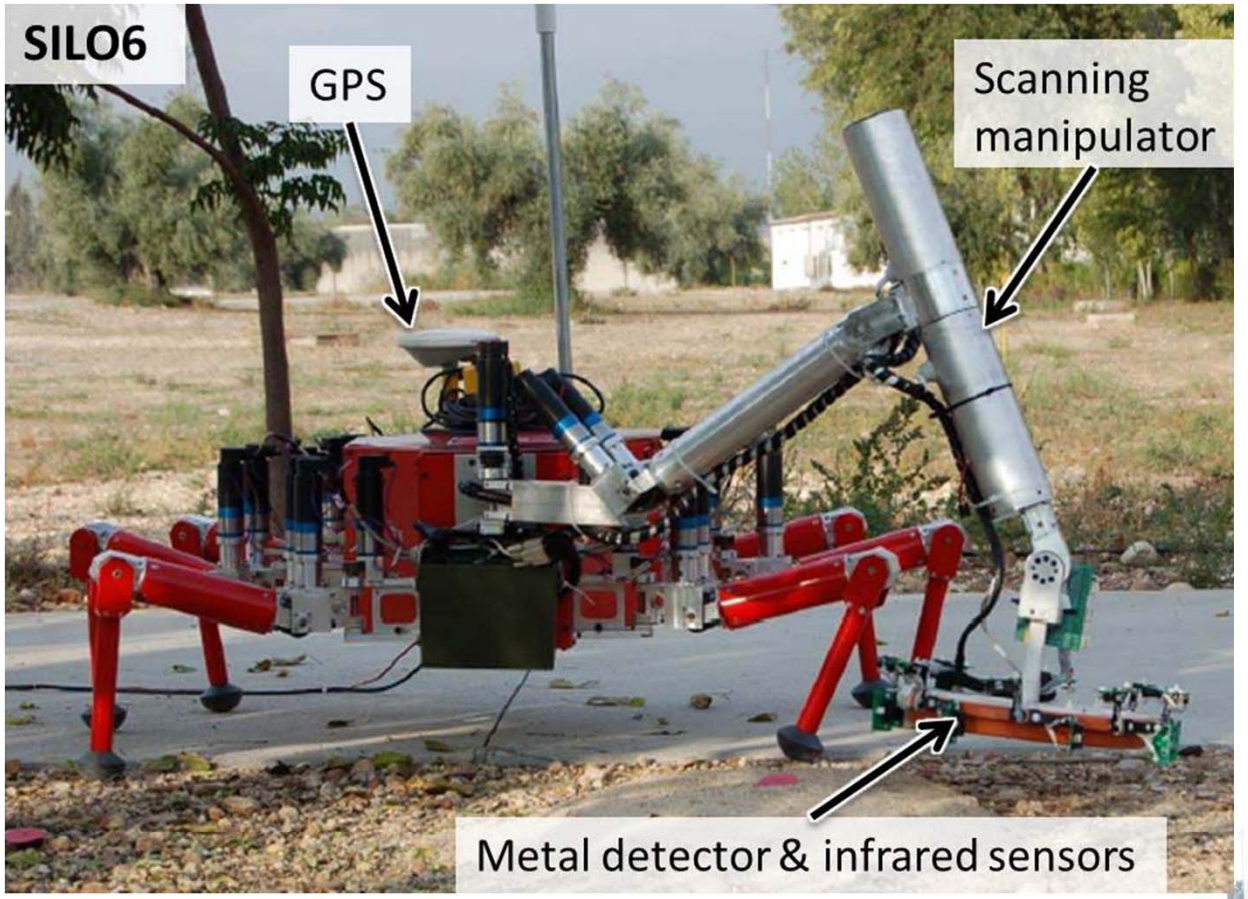


The SILO6 walking robot

- SILO6 is an autonomous walking robot with six legs designed to detect and localize antipersonnel mines.
  - It carrying a scanning manipulator with a metal detector installed on the tool centre point.
  - A set of infrared sensors are assembled around the MD.
  - The infrared sensors are used for tracking the ground level and to detect any obstacle to height of the sensor head.
  - DGPS system for georeference its position.



The SILO6 walking robot

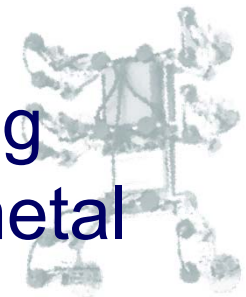


Body dimensions (mm)				Mass (kg)
Length	Width front/rear	Width middle	Height	
880	200	450	260	44.34

The SILO6 walking robot

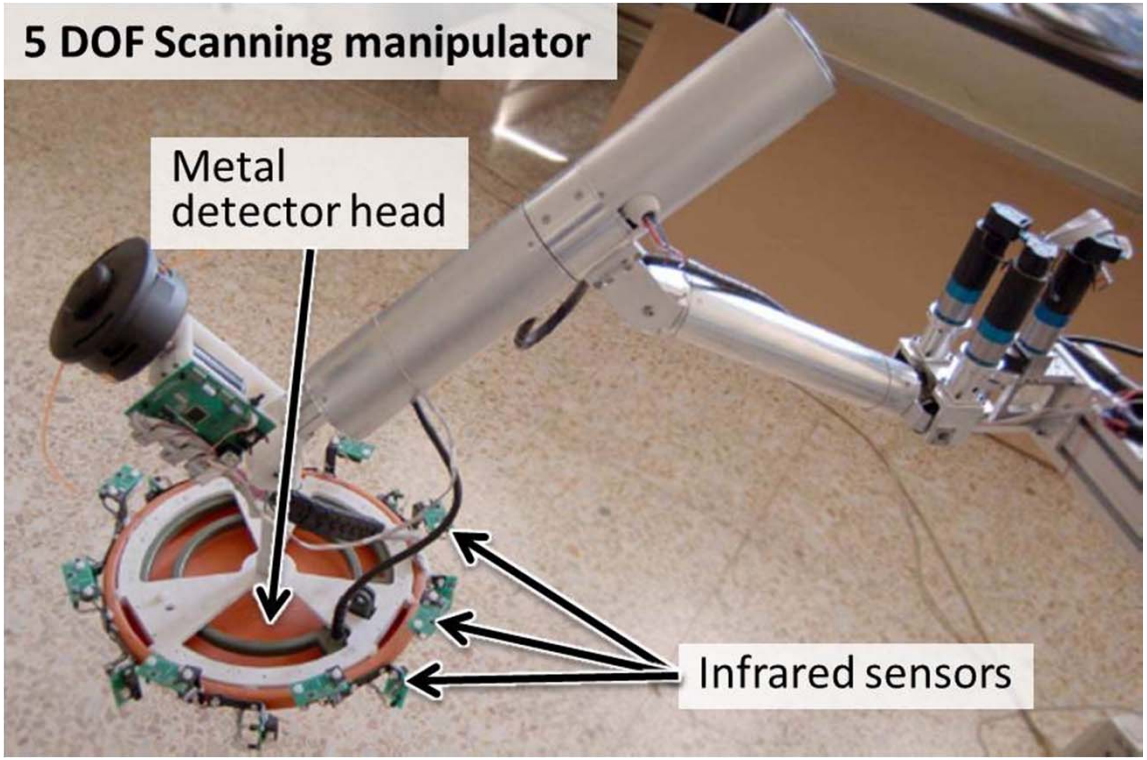
Scanning manipulator

- The scanning manipulator has 5 rotational joints in elbow-up configuration,
- It provides sufficient mobility and reduces possible undesirable contacts with other parts of the robot or objects in its environment.
- Together with the walking robot, the scanning manipulator orients toward the ground the metal detector coupled at its end.
- This manipulator is also actuated by DC motors.



The SILO6 walking robot

Scanning manipulator



Degree of freedom	**5**
Stability	High
Mass	7.1 kg
Maximum range	942 mm
Power supply	16-30 VDC, Typ. 24 VDC

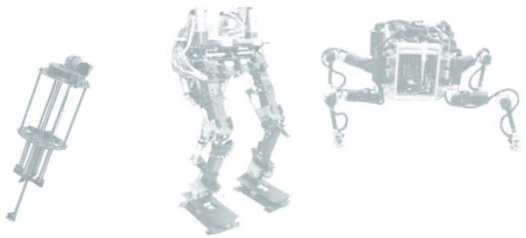
The SILO6 walking robot

- Several kind of trajectories executed by SILO6 (8x)

- Scanning tasks with the manipulator on-board of SILO6 (4x)

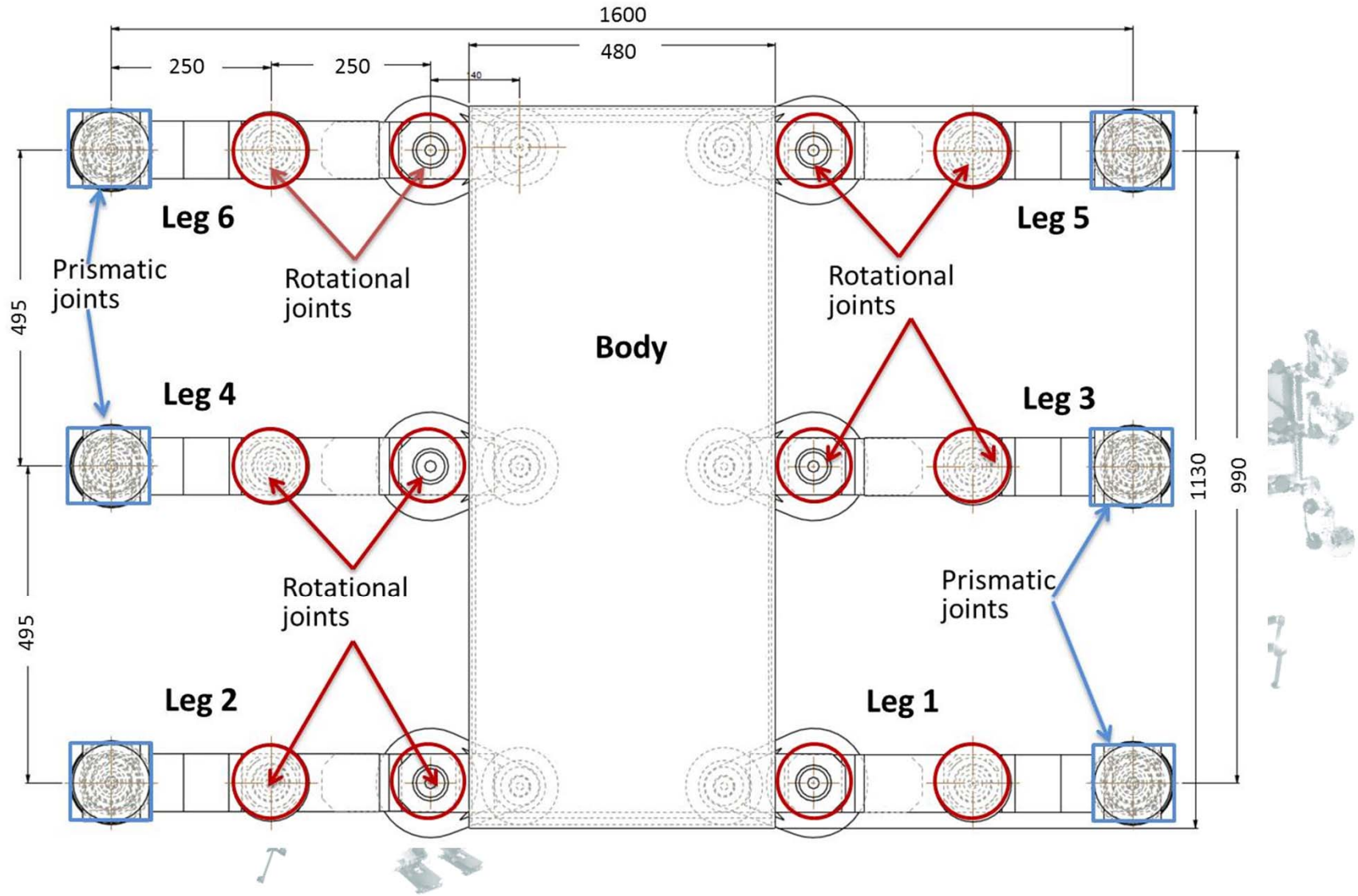
Hexapod robot

- The “new hexapod robot” has been considered to use within TIRAMISU project instead of using the SILO6 walking robot, for the following reason:
  - Some deformation in joints, specifically, in the gears located in the shoulders have appeared.
  - This is due to the momentum caused by the manipulator arm together with the uneven terrain, while the robot has been walking.



Hexapod robot

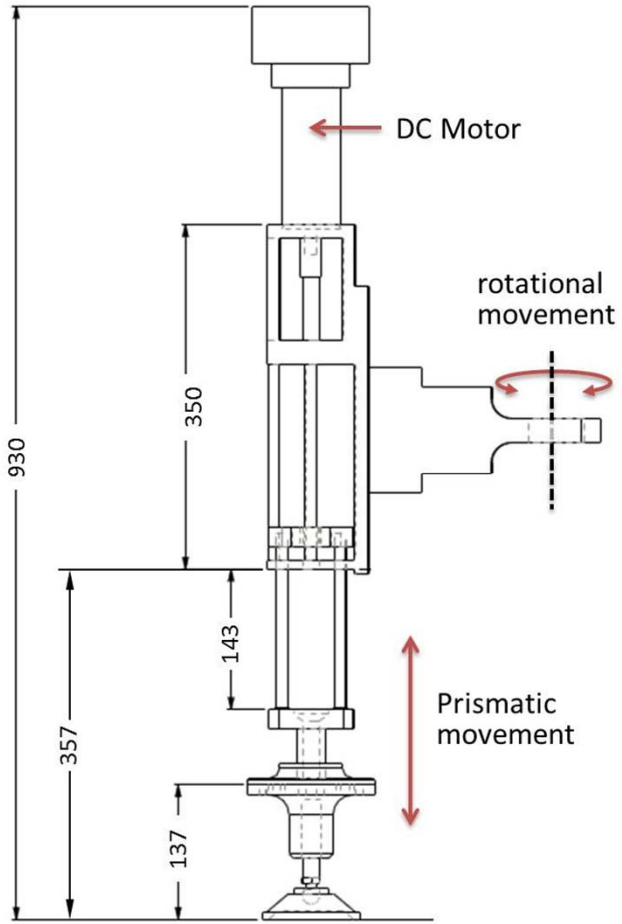
Mechanical design

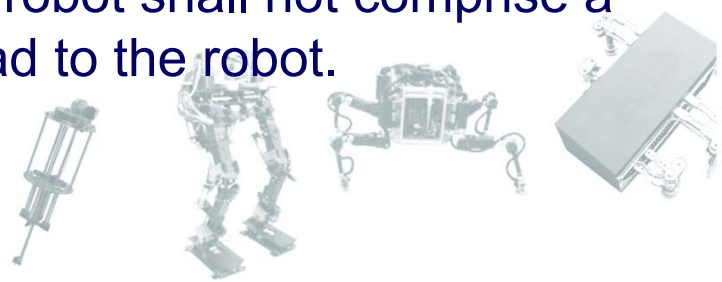


Hexapod robot

Mechanical design

- Each leg of the hexapod robot has a SCARA configuration (RRP).
- This configuration decouples gravitationally the movement of the body robot.
- For this reason, this hexapod robot has an energetic autonomy relatively high, besides it can carry high a payload according to its size. This hexapod robot can handle masses of up to 300 kg.
- Consequently, the manipulator arm with metal detector and other sensors and devices which will be installed on-board of this hexapod robot shall not comprise a significant load to the robot.

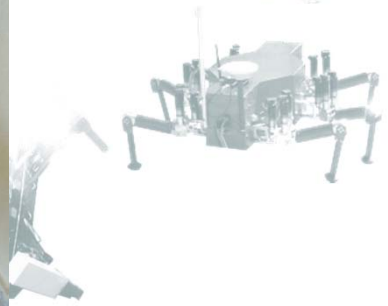




Hexapod robot

- Main mechanical characteristics of the hexapod walking robot

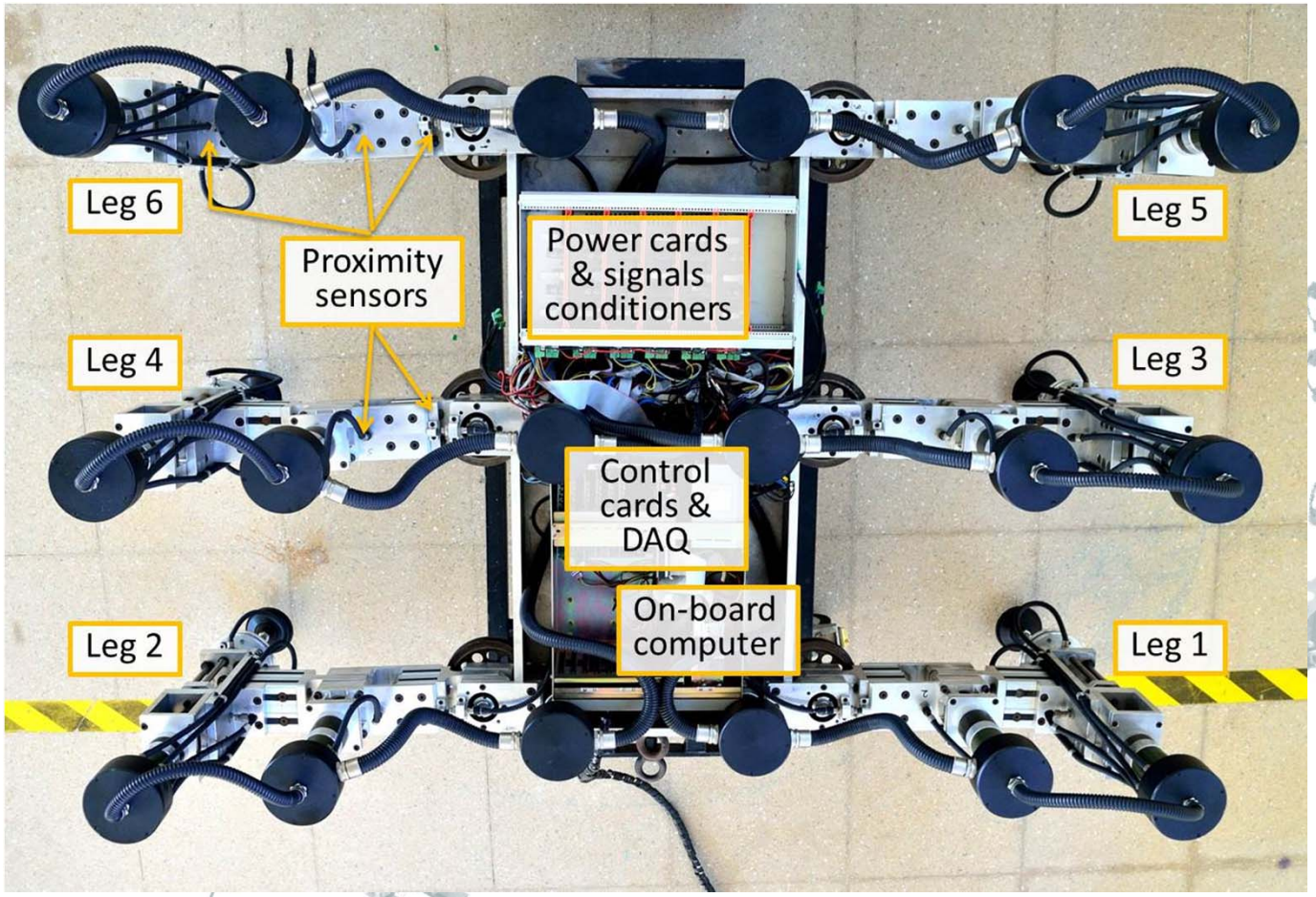
Degrees of freedom		18
Stability		High
Robot mass		250 kg
Payload capacity		Up to 300 kg
Obstacle height to surpass		Up to 200 mm
Power supply		16-30 VDC, Typ. 24 VDC
Body size	Length	1130 mm
	Width	480 mm
Robot size	Max length	1130 mm
	Max width	1700 mm



Hexapod robot

System architecture

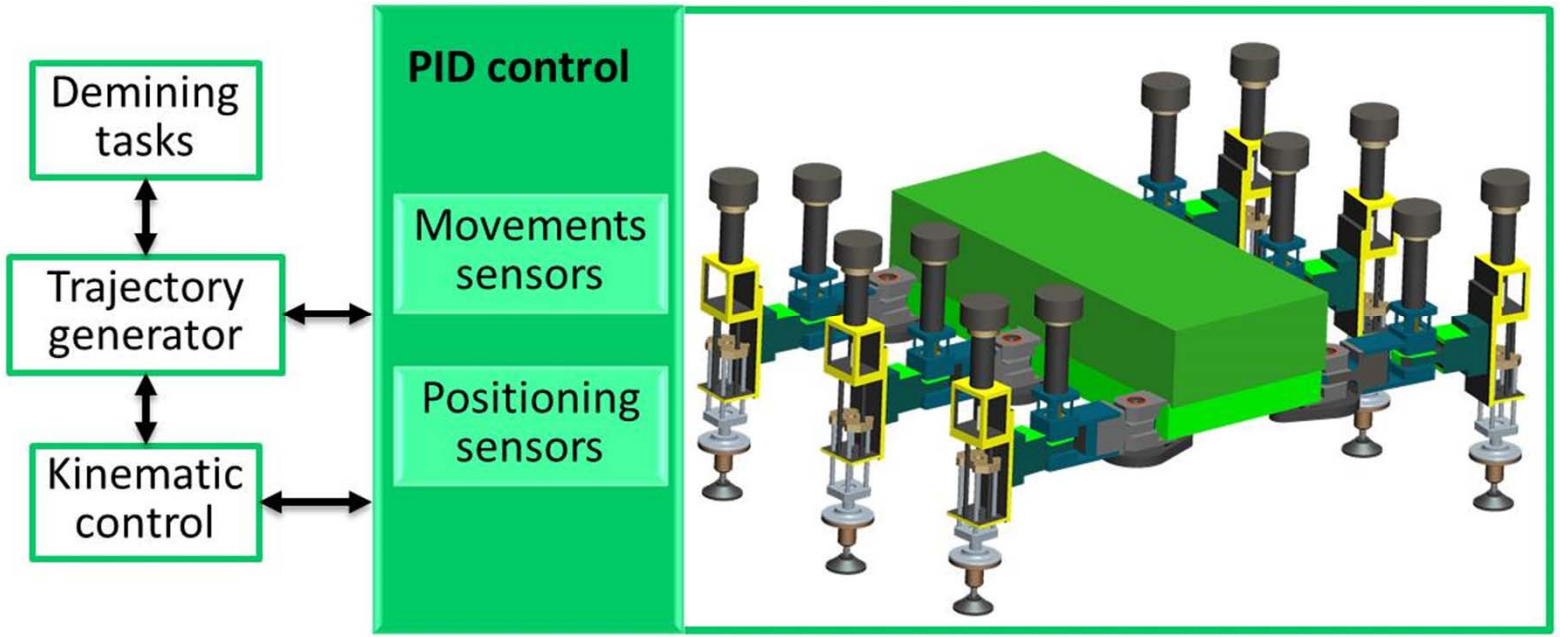
- More important subsystems that comprise the control architecture installed on the hexapod robot.



Hexapod robot

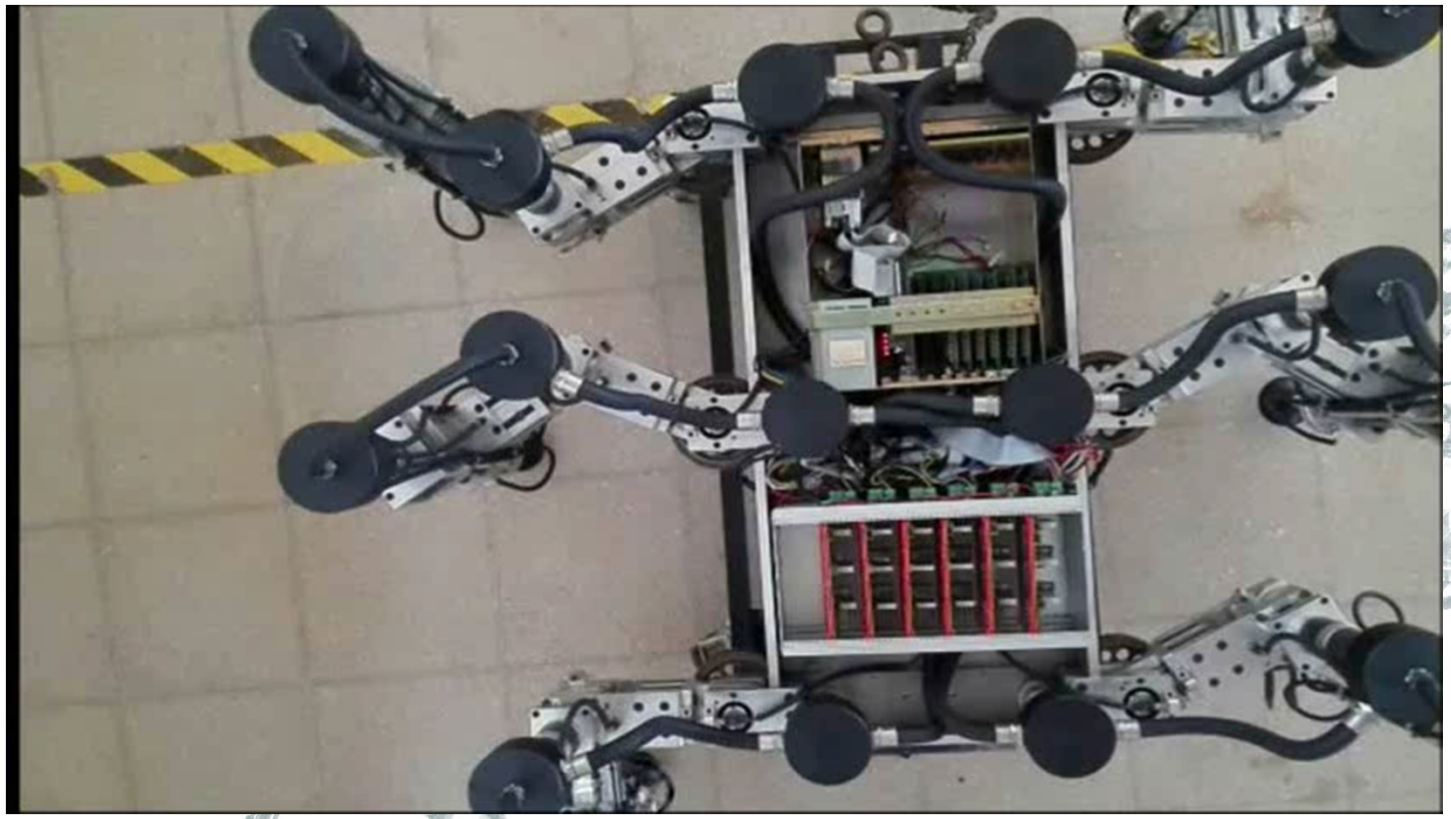
System architecture

- The motion of the robot is proposed by mean of the strategies demining tasks, which is sent to trajectory generation stage. This stage using the robot kinematic and the PID control performs the controlled movement of the hexapod robot.



Experimental tests

- Initialization of the robot
  - Initialization of the robot legs (2x)
  - Posture of the legs in gait way (2x)



Experimental tests

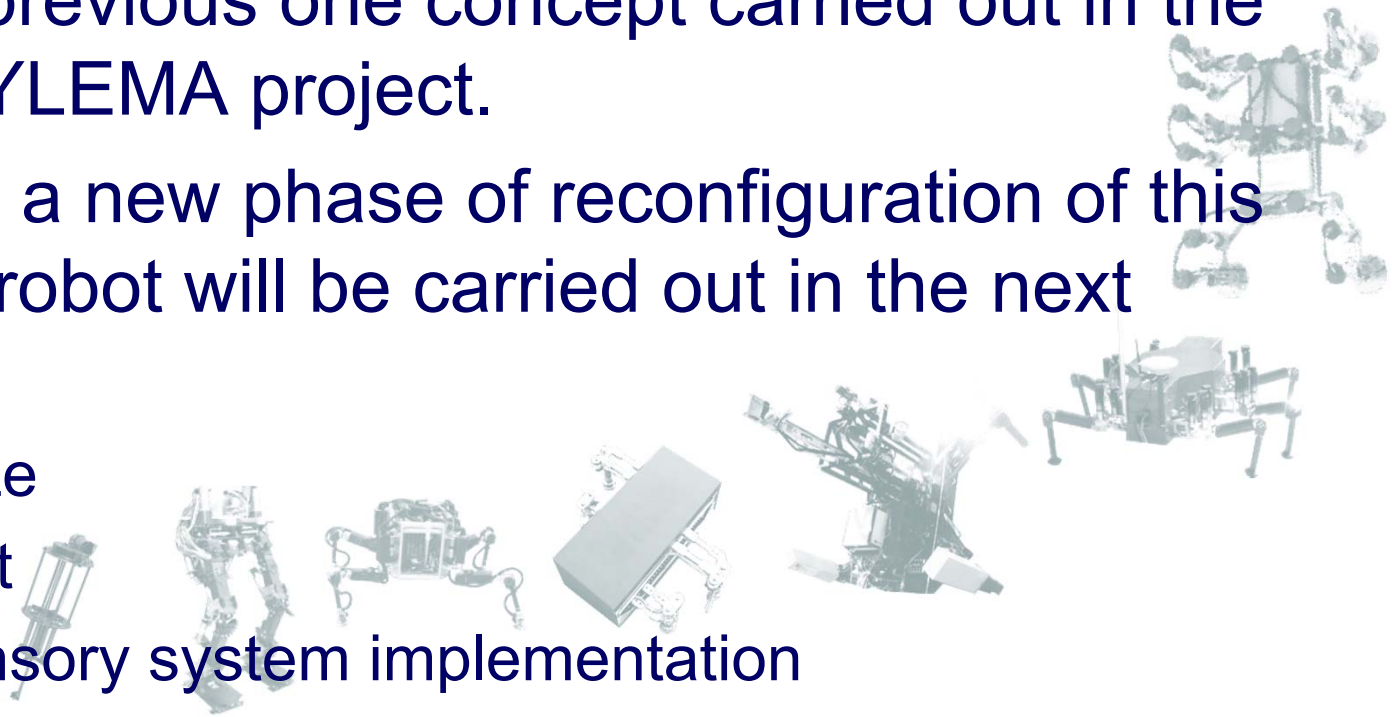
- Scanning tests in CSIC lab

Scanning in fixed position

Scanning in movement

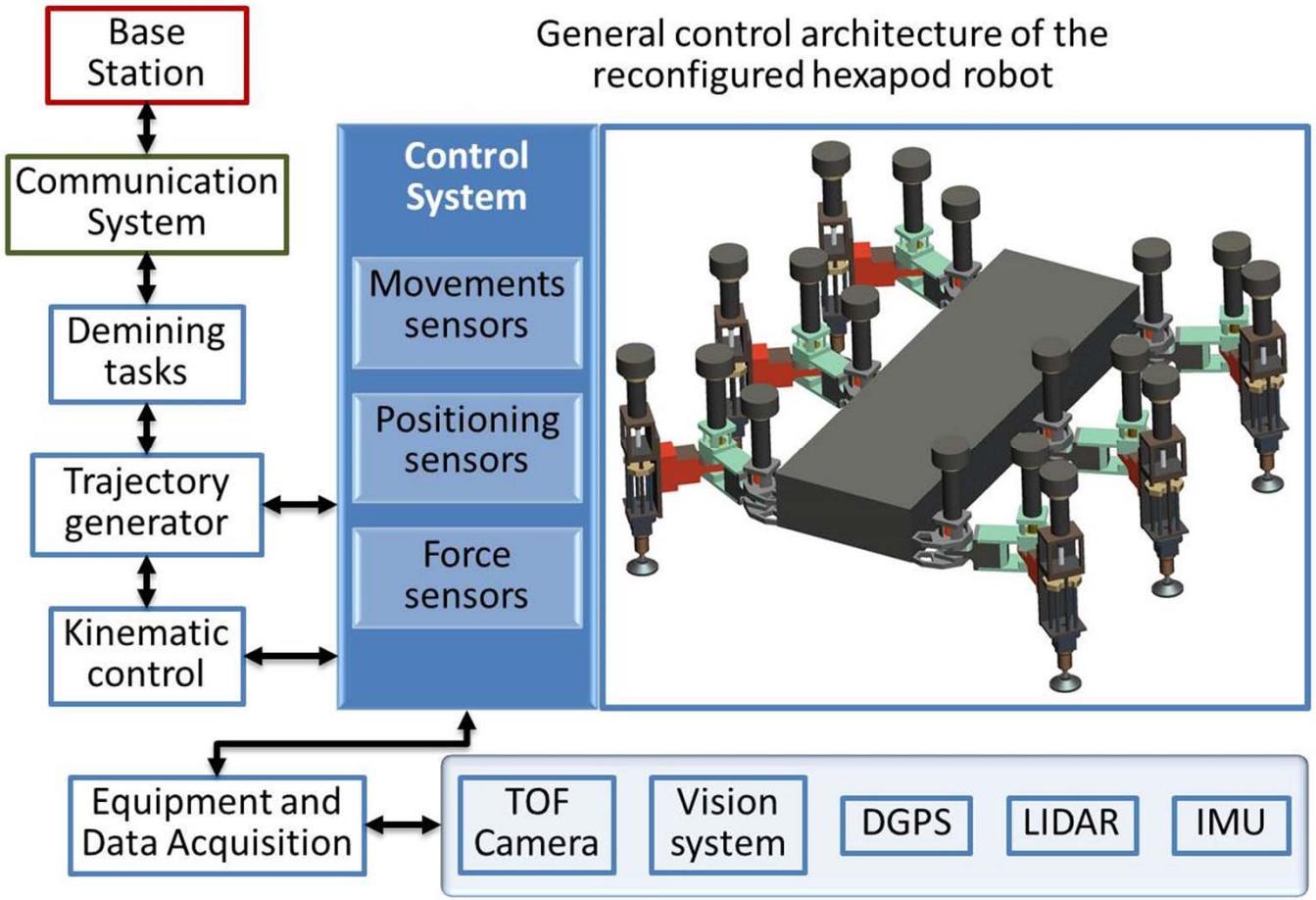
Conclusions and Future Works

- In preliminary experimental tests in CSIC lab, the hexapod robot has demonstrated high stability during the performance of several gaits.
- The coordination between the scanning manipulator and the hexapod robot will be similar than the previous one concept carried out in the SILO6-DYLEMA project.
- However, a new phase of reconfiguration of this hexapod robot will be carried out in the next weeks.
  - Body size
  - New feet
  - New sensory system implementation



Conclusions and Future Works

- General control architecture proposed for the reconfigured hexapod robot



THANK YOU FOR YOUR ATTENTION!