RoCKIN 2014

CITÉ DE L' ESPACE
TOULOUSE, FRANCE

26 - 30 NOVEMBER

Credit: Manuel Huynh

PARTNERS

RÉGION MIDI-PYRÉNÉES

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SMARTIF

Funded by the European Union

Foreword

Robotics technology will become dominant in the coming decade. Industrial robots have the potential to transform work practices, to raise efficiency, productivity and safety levels, to provide enhanced levels of quality and to create jobs. Professional service robotics technology will have a major impact in domains such as agriculture, transport or healthcare for example. Domestic service robots will change all aspects of our daily life, supporting and helping us in many different tasks.

The EU has been funding research into Cognitive Systems & Robotics since May 2004 and helping Europe to become a world-leader in this field. The EU's Robotics programme supports over 100 research projects, involving several hundred of Europe's top researchers from academia and industry, with a funding of nearly €700 million in the last five years. It aims to make robots more intelligent, more autonomous and more capable of assisting humans in everyday tasks.

RoCKIn was selected under the 9th Call of the FP7 in Communication and Information Technologies which had the goal of speeding up progress towards smarter robots through targeted competitions.

The RoCKIn competitions are demonstrating how robots can efficiently support humans in domestic and industrial tasks, providing realistic and useful scenarios to researchers to test and evaluate their results, and contributing to a wider benchmarking culture in robotics. They are also a unique opportunity for young European researchers to meet and to share experience, and for the public who will attend the event to witness how science can contribute to well-being and progress in our daily lives.

This event could not take place without the hard work and commitment of the project members, the help of the local organisers and the support of the sponsors.

As the EU project officer for RoCKIn, I have the opportunity to follow its development and its findings closely. I am convinced that this first competition will stimulate a great deal of interest in the work carried out and I wish all the participants and visitors an exciting, challenging and memorable event.

Anne Bajart, PhD
Project Officer
Robotics, Directorate General Communication Networks, Content and Technology, European Commission

Background

In the last 20 years, robot competitions have emerged as a powerful means to foster progress in robotics research and development (R&D). By combining the scientific rigor and repeatability of experiments with the real-world relevance and spectacle of competitive events, they are able to offer a highly complementary approach to traditional lab-based R&D.

Some robot competitions focus on challenges that concern "real-world" problems, solvable in a relatively short time horizon, e.g. the DARPA Grand Challenge; others target a long-term future challenge that requires participants to build up highly innovative research year on year in order to handle the competition's requirements, e.g. RoboCup's challenge of building a humanoid soccer team capable of defeating the human winners of the FIFA 2050 World Cup. In both instances the challenges are demanding and scalable to real-world scenarios, and often lead to solutions for problems beyond the originally stated challenge.

Kiva Systems robots at work
© Dawghause Photography

RoboCup 2014, © Valdecir Becker/UFPB

Success stories

RoboCup was launched in 1997 by a group of international Artificial Intelligence researchers. Its long-term mission is to get a fully functioning soccer team that can compete against the human winners of the 2050 FIFA World Cup, according to the official FIFA football rules. Over the last decade RoboCup has extended its domain to domestic and service robots (RoboCup@Home), search and rescue robots (RoboCupRescue) and, industrial robots (RoboCup@Work). Among RoboCup's many success stories, a few of its alumni are particularly worthy of mention:

Kiva Systems: a company that revolutionized automation by using hundreds of mobile robots for storing, moving and sorting inventory in automated warehouses. In 2012, Kiva Systems was acquired by Amazon. Co-founder, Raffaello d'Andrea, now a professor at ETHZ, Switzerland, credited RoboCup and robot soccer for the success of his company: "The robotic aspects of Kiva Systems had their genesis in robot soccer".

Aldebaran Robotics' NAO robot: today this robot is recognized by robotics research labs worldwide and quickly became a commercial success after it was introduced as the standard platform for RoboCup Soccer 's Standard Platform League. Aldebaran Robotics was recently bought by the Japanese company 'Softbank', which wants to make it the world's leading provider of domestic service robots.

RoboCup, 2014, © Valdecir Becker/UFPB

Quince: this Search and Rescue (SaR) robot played a vital role in the rescue operations following the Fukushima-Daiichi Nuclear Power Plant disaster, being the only robot that could reach the 2nd - 5th floors in the nuclear reactor buildings. Quince was developed by the New Energy and Industrial Technology Development Organization (NEDO) in Japan, under the coordination of Satoshi Tadokoro, a professor at Tohoku University. Prof. Tadokoro is a former RoboCup Trustee, and leader of the team that participated with Quince in RoboCupRescue.

DARPA Grand Challenge: The Defense Advanced Research Projects Agency (DARPA), which is part of the United States Department of Defense, launched its well-known Grand Challenge in 2004 in order to stimulate the development of autonomous ground vehicles. While there was no winner for the first competition in 2004, the technical progress made by the contestants was revolutionary and the follow-on competition in 2005 produced five cars that completed the test-course. In 2007, DARPA launched a modification with its Urban Challenge that requested autonomous vehicles to drive in an urban environment. The now well-known Google driverless car was developed by the team coordinated by Sebastian Thrun, from University of Stanford, that won the DARPA Grand Challenge in 2005 and was runner-up in 2007. Widespread use of commercial autonomous cars could soon become a reality and many European companies lead the market on this front.

DARPA, 2007 Winner, Tartan Racing

Beyond R&D

The impact of robot competitions is not restricted to advancements in R&D. The appeal of robot competitions to the general population makes them the ideal vehicle for raising awareness of the impact research achievements in Science and Technology (S&T), and robotics in particular, have on societal issues.

Events specifically targeted at the younger generation, such as RoboCupJunior, are able to encourage them to engage in technology studies and research careers by providing an early opportunity to experiment with robots, as well as by demonstrating the accessibility and trans-disciplinary nature of field. Additionally, involvement in these competitions can be highly beneficial for developing a broader range of transferable skills: building the ability to work as a team, solve problems under pressure and use multi-disciplinary knowledge to develop integrated complex systems.

Real-world impacts

Robot competitions have demonstrated their ability to take advanced technologies and methods from the lab to the field, and have furthered the state of the art in providing integrated approaches to grand challenges. Participating researchers from all over the world, with different backgrounds, converge and compete to show their best solutions to the same challenge. Through annual rule updates and constraints removal, scientific competitions have well-established principles for progressing research towards richer challenges and more realistic robotic systems. Furthermore, competitions provide very challenging experimental settings with partially uncontrolled conditions. In this respect, they go far beyond the typical research laboratory scenarios, where the solution can be often only be demonstrated under specific conditions that are not easily reproduced in more realistic settings.

What is...

RoCKIn is an EU-funded project aiming to foster scientific progress and innovation in cognitive systems and robotics through the design and implementation of competitions. An additional objective of RoCKIn is to increase public awareness of the current state of the art in robotics in Europe and to demonstrate the innovation potential of robotics applications for solving societal challenges and securing the competitiveness of European industry in global markets.

In order to achieve these objectives, RoCKIn has developed two competitions for:

- Domestic service robots (RoCKIn@Home)
- Industrial robots in factories (RoCKIn@Work)

These competitions are designed around Challenges that are based on easy-to-communicate and convincing user stories, which catch the interest of both the general public and the scientific community. Of particular interest to the latter is openly solving scientific challenges and the opportunity to thoroughly assess, compare, and evaluate competing approaches. To allow this to happen, the competitions are designed to meet the requirements of benchmarking procedures and good experimental methods. The integration of benchmarking technology with the competition concept is one of the main objectives of RoCKIn.

The RoCKIn project:

- Designs open domain test beds for the competitions which are usable by researchers worldwide
- Develops methods for benchmarking through competitions that allow for the assessment of both particular subsystems as well as the integrated system
- Organizes two robot competition events (in 2014 and 2015), each of them based on the two Challenges and test beds
- Organizes camps open to student participants, so as to help new teams get involved in the competitions
- Executes dissemination activities to target stakeholders in industry and academia, as well as the general public

RoCKIn is one of two pioneering robot competition projects supported by the European Commission under the Seventh Framework Programme for Research (FP7). The other project, euRathlon, is a new outdoor robotics competition which invites teams to test the intelligence and autonomy of their robots in realistic mock emergency-response scenarios.

The Challenges

Ensuring the continued competitiveness of Europe's manufacturing industry

This Challenge is looking for innovative industrial robots that can help businesses meet increasing demand from their customers. Set in the RoCKIn & RoLLIn factory, a youBot will assist with the assembly of a drive axel - one component of the youBot itself and therefore a step towards self- replicating robots. Tasks include locating, transporting and assembling necessary parts, checking their quality and prepping them for other machines and workers. YouBots will be working interactively as personal mobile assistants in a highly flexible and continuously changing production line.

Robots will be benchmarked on **3** tasks and **2** functionalities

Tasks

Robots will perform three tasks needed in the assembly of a drive axle – one component of the youBot itself and therefore a step towards self-replicating robots.

Assemble Aid Tray For Force Fitting
Assembly-aid trays, bearing boxes and bearings are identified, transported to the relevant rig and fitted together with the help of another machine.

Plate Drilling
Cover plates coming along a conveyer belt are individually inspected using a quality control camera and sorted, with those in need of drilling being taken to the relevant rig and placed ready for another machine to perform the drilling.

Prepare a Box for Manuel Assembly Step
After taking verbal instruction from a human worker, the robot goes around the various Workstations in the arena and collects a machined cover plate, pre-assembled bearing box, and motor with gearbox and encoder. The robot then delivers this box to a human worker for them to finish assembling the drive axel. Throughout this process, robots must report and/or solve errors such as storage areas being occupied by other robots and parts being on the wrong shelf.

Functionalities

The following functionalities will then be benchmarked across tasks:

Object Perception

The objective of this benchmark is to assess the capabilities of a robot in processing sensor data in order to extract information about observed objects from the objects presence, estimate their class, identity and location.

Visual Servoing

The robot must be capable in controlling the manipulator motion based on its own visual perception.

RoCKIn@Work Arena

Platform

Tasks must be completed using a platform with mobile manipulation capabilities such as the KUKA YouBot. Modifications to the platform are allowed but not to the environment or networked devices installed in the environment.

The Challenges

Improving the quality of home life for the people of Europe

This challenge will focus on assisting the elderly or impaired. Robots will be helping Grannie Annie - an elderly lady who needs some support to keep her healthy and doing the things she loves. Set in Granny Annie's apartment, tasks will include identifying and reacting appropriately to four different visitors to the apartment, getting familiar with its surroundings and helping Granny Annie with everyday activities such as opening and closing the window blinds.

Robots will be benchmarked on **3** tasks and **3** functionalities

Tasks

Getting to Know my Home

Here the robot will be required to generate a map of its environment and detect random changes in the location of furniture and other items that will be made before each task.

Welcoming Visitors

This task assesses the robot's capability to interact effectively with humans and to demonstrate different behaviors when dealing with known and unknown people.

Catering for Granny Annie's Comfort

Granny Annie will ask the robot to help her with general tasks throughout her day, she wants the robot to lift the shutters , tilt the windows and switch off the lights amongst other duties.

Functionalities

The following functionalities will then be benchmarked across tasks:

Object Perception
When presented with objects from a given list of commonplace items found in a domestic home e.g. a bottle of milk , robots will need to detect their presence, estimate their class, identity and location.

Object Manipulation
The robot must correctly operate manual commands of the types that are commonly found on domestic appliances operated by humans. This will include both digital (i.e. on/off) and analog controls.

Speech Understanding
A list of predefined recognisable commands that a user gives in a home in environment will need to be understood by capturing audio from an on-board microphone and then correctly interpreted.

Platform

Teams can use either one or more fully autonomous robots to solve the tasks. Robots must conform to certain size, weight, safety restrictions and are wirelessly networked with other devices, such as motorised blinds + surveillance cameras. Teams are not allowed to modify the environment or add additional devices.

Benchmarking in RoCKIn

Benchmarking in RoCKIn has been designed so as to minimise subjective evaluations and to allow for the quality of sub-system components to be recognised as well as success in performing the overall task. Though the careful design and revision of the challenge rules we hope to allow for the comparison of performances across years

Tasks will be benchmarked against the extent to which they successfully complete the required actions (such as understanding commands, correctly operating and/or identifying objects and devices etc.) and how effectively they do so, with penalties being given for actions such as bumping into Granny Annie or furniture for RoCKIn@Home. Penalties or disqualification in RoCKIn@Work will be given for actions such as damaging objects or the testbed.

@Work Teams

SPQR@Work

University of Rome, Italy

Team Leader: Alberto Pretto

b-it-bots

Bonn- Rhein-Sieg University of Applied Sciences, Germany

Team Leaders: Oscar Lima and Alexander Moriarty

IASLab@Work

University of Padua, Italy

Team leader:

Michele Marostica

@Home Teams

BARC

University of Birmingham, United kingdom

Team Leader: Lenka Mudrova

Homer@UniKoblenz

University of Koblenz-Landau, Germany

Team Leader: Viktor Seib

Donaxi@HOME

Universidad Popular Autónoma del Estado de Puebla, Mexico

Team Leader: Hector Vargas

Watermelon Project

University of León, Spain

Team Leader: Francisco Lera

B-it-Bots@Home

Bonn- Rhein-Sieg University of Applied Sciences, Germany

Team Leaders: Shehzad Ahmed and Iryna Ivanovska

Pumas@Home

Universidad Nacional Autonoma de Mexico, UNAM, Mexico

Team Leader: Jesus Savage

Ursus-Team

Robolab - University of Extremadura, Spain

Team Leaders: Marco A. Gutierrez and Pablo Bustos

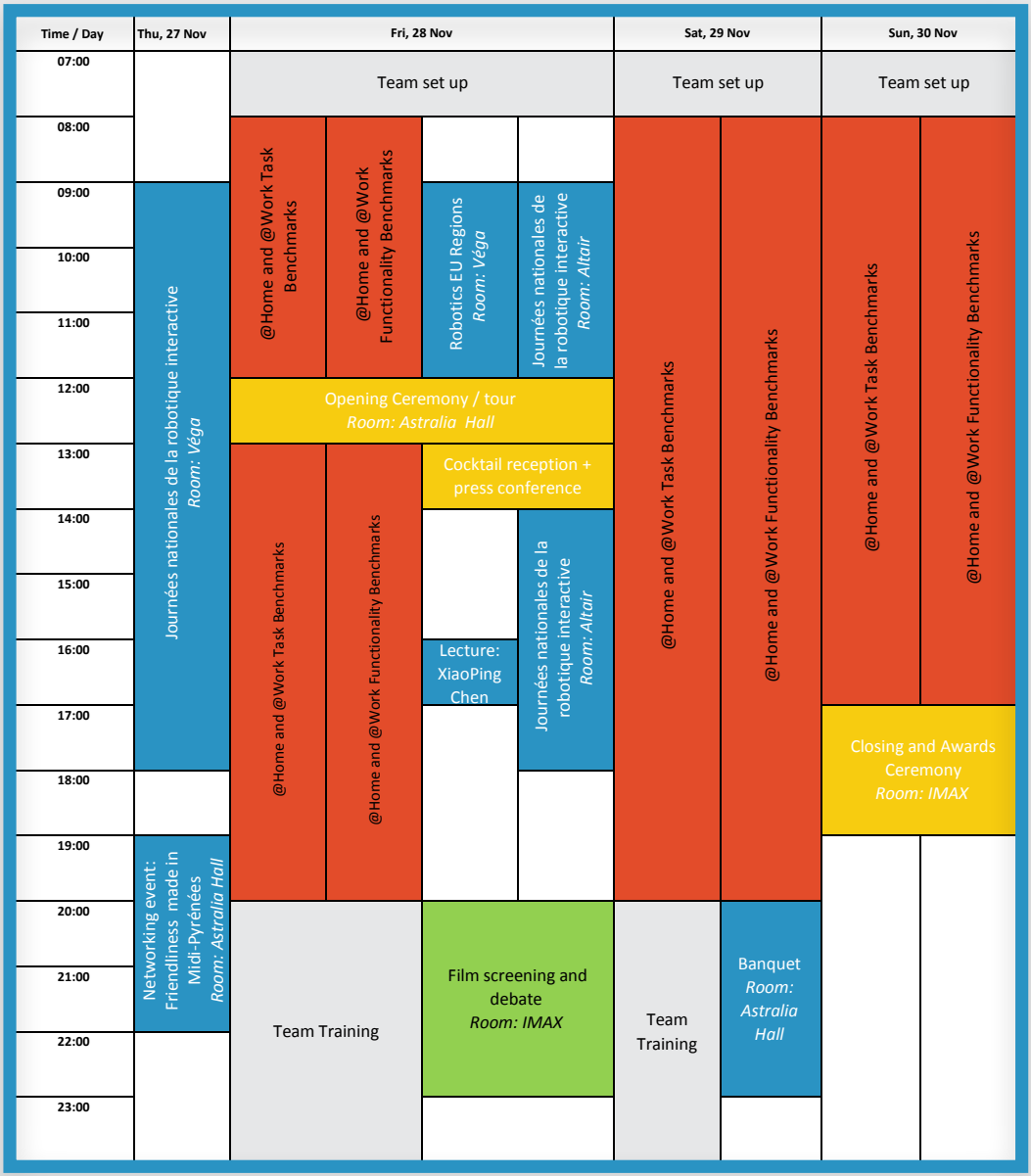
SocRob@home

Instituto Superior Técnico - Institute for Systems and Robotics, Portugal

Team Leader: Rodrigo Ventura

For more information on our teams please visit:
http://rockincompetition.eu/teams

RoCKIn Competition Schedule



RoCKIn@Home Testbed Occupation

DAY 1					
	TB area @Home	TEAM	Time Slot	TEAM	FB area @Home
ROUND 1	TBM 1H (Round 1)	HT1	08:00 - 08:25	HT5	FBM 1H (Round 1)
		HT2	08:25 - 08:50	HT6	
		HT3	08:50 - 09:15	HT7	
		HT4	09:15 - 09:40	HT1	
		HT5	09:40 - 10:05	HT8	
		HT6	10:05 - 10:30	HT3	
		HT7	10:30 - 10:55	HT4	
			10:55 - 11:20		
			11:20 - 11:45		
			11:45 - 12:10		
	Opening		12:10 - 13:05	Opening	
	TBM 2H (Round 1)	HT1	13:05 - 13:30		
		HT2	13:30 - 13:55		
		HT3	13:55 - 14:20	HT7	FBM 2H (Round 1)
		HT4	14:20 - 14:45	HT8	
		HT5	14:45 - 15:10		
		HT6	15:10 - 15:35		
			15:35 - 16:00		
			16:00 - 16:25		
	FBM 3H (Round 1)	ALL	16:25 - 16:50	WT1	FBM 1W (Round 1)
			16:50 - 17:15	WT2	
			17:15 - 17:40	WT3	
			17:40 - 18:05		
	TBM 2H (Round 1)	HT7	18:05 - 18:30	HT1	FBM 2H (Round 1)
		HT8	18:30 - 18:55	HT3	
			18:55 - 19:20	HT4	
			19:20 - 19:45	HT5	
			19:45 - 20:10		

DAY 2					
	TB area @Home	TEAM	Time Slot	TEAM	FB area @Home
mixed ROUND1 + ROUND2	TBM 3H (Round 1)	HT1	08:00 - 08:25	WT1	FBM 2W (Round 1)
		HT2	08:25 - 08:50	WT2	
		HT3	08:50 - 09:15	WT3	
		HT4	09:15 - 09:40		
		HT5	09:40 - 10:05	WT1	FBM 1W (Round 2)
		HT6	10:05 - 10:30	WT2	
		HT8	10:30 - 10:55	WT3	
		HT9	10:55 - 11:20		
			11:20 - 11:45		
ROUND 2	TBM 1H (Round 2)	TBA	11:45 - 12:10	WT1	FBM 2W (Round 2)
		TBA	12:10 - 12:35	WT2	
		TBA	12:35 - 13:00	WT3	
		TBA	13:00 - 13:25		
		TBA	13:25 - 13:50		
		TBA	13:50 - 14:15	TBA	FBM 2H (Round 2)
			14:15 - 14:40	TBA	
	TBM 2H (Round 2)	TBA	14:40 - 15:05	TBA	
		TBA	15:05 - 15:30	TBA	
		TBA	15:30 - 15:55	TBA	
		TBA	15:55 - 16:20		
			16:20 - 16:45		
	TBM 2H (Round 2)	TBA	16:45 - 17:10	TBA	FBM 1H (Round 2)
		TBA	17:10 - 17:35	TBA	
		TBA	17:35 - 18:00	TBA	
			18:00 - 18:25	TBA	
	TBM 3H (Round 2)	TBA	18:25 - 18:50	TBA	
		TBA	18:50 - 19:15	TBA	
		TBA	19:15 - 19:40	TBA	
		TBA	19:40 - 20:05		

TBM 1H Getting to know my home
TBM 2H Catering for Grannie Annie's comfort
TBM 3H Welcoming visitors

FBM 1H Object Perception functionality
FBM 2H Object Manipulaton functionality
FBM 3H Speech Understanding functionality

DAY 3					
	TB area @Home	TEAM	Time Slot	TEAM	FB area @Home
mixed ROUND2+ ROUND3	TBM 3H (Round 2)	TBA	08:00 - 08:25	WT1	FBM 1W (Round 3)
		TBA	08:25 - 08:50	WT2	
			08:50 - 09:15	WT3	
	FBM 3H (Round 2)	ALL	09:15 - 09:40		
			09:40 - 10:05		
ROUND 3	TBM 1H (Round 3)	TBA	10:05 - 10:30		
		TBA	10:30 - 10:55	TBA	FBM 1H (Round 3)
		TBA	10:55 - 11:20	TBA	
		TBA	11:20 - 11:45	TBA	
			11:45 - 12:10	TBA	
	TBM 2H (Round 3)	TBA	12:10 - 12:35		
		TBA	12:35 - 13:00	TBA	FBM 2H (Round 3)
		TBA	13:00 - 13:25	TBA	
		TBA	13:25 - 13:50	TBA	
			13:50 - 14:15	TBA	
	TBM 3H (Round 3)	TBA	14:15 - 14:40		
		TBA	14:40 - 15:05		
		TBA	15:05 - 15:30	WT1	FBM 2W (Round 3)
		TBA	15:30 - 15:55	WT2	
			15:55 - 16:20	WT3	
	FBM 3H (Round 3)	ALL	16:20 - 16:45		
		Closing	17:00-19:00	Closing	

RoCKIn@Work Testbed Occupation

DAY 1			
	TB area @Work	TEAM	Time Slot
ROUND 1	TBM 1W (Round 1)	WT1	08:00 - 08:25
		WT2	08:25 - 08:50
		WT3	08:50 - 09:15
			09:15 - 09:40
			09:40 - 10:05
	TBM 2W (Round 1)	WT1	10:05 - 10:30
		WT2	10:30 - 10:55
		WT3	10:55 - 11:20
			11:20 - 11:45
			11:45 - 12:10
	Opening		12:10 - 13:05
			13:05 - 13:30
			13:30 - 13:55
	TBM 3W (Round 1)	WT1	13:55 - 14:20
		WT2	14:20 - 14:45
		WT3	14:45 - 15:10
			15:10 - 15:35
			15:35 - 16:00
			16:00 - 16:25
			16:25 - 16:50
			16:50 - 17:15
			17:15 - 17:40
			17:40 - 18:05
			18:05 - 18:30
			18:30 - 18:55
			18:55 - 19:20
			19:20 - 19:45
			19:45 - 20:10

DAY 2			
	TB area @Work	TEAM	Time Slot
			08:00 - 08:25
			08:25 - 08:50
			08:50 - 09:15
ROUND 2			09:15 - 09:40
			09:40 - 10:05
			10:05 - 10:30
			10:30 - 10:55
			10:55 - 11:20
			11:20 - 11:45
			11:45 - 12:10
			12:10 - 12:35
			12:35 - 13:00
			13:00 - 13:25
	TBM 1W (Round 2)	WT1	13:25 - 13:50
		WT2	13:50 - 14:15
			14:15 - 14:40
			14:40 - 15:05
	TBM 2W (Round 2)	WT1	15:05 - 15:30
		WT2	15:30 - 15:55
			15:55 - 16:20
			16:20 - 16:45
	TBM 3W (Round 2)	WT3	16:45 - 17:10
		WT1	17:10 - 17:35
		WT2	17:35 - 18:00
			18:00 - 18:25
			18:25 - 18:50
			18:50 - 19:15
			19:15 - 19:40
			19:40 - 20:05

TBM 1W Prepare Assembly aid tray for force fitting
TBM 2W Plate drilling
TBM 3W Fill a box with parts with manual assembly

FBM 1W Object Perception functionality
FBM 2W Visual Servoing functionality

DAY 3			
	TB area @Work	TEAM	Time Slot
ROUND 3			08:00 - 08:25
			08:25 - 08:50
			08:50 - 09:15
			09:15 - 09:40
	TBM 1W (Round 3)	WT1	09:40 - 10:05
		WT2	10:05 - 10:30
		WT3	10:30 - 10:55
			10:55 - 11:20
	TBM 2W (Round 3)	WT1	11:20 - 11:45
		WT2	11:45 - 12:10
		WT3	12:10 - 12:35
			12:35 - 13:00
			13:00 - 13:25
	TBM 3W (Round 3)	WT1	13:25 - 13:50
		WT2	13:50 - 14:15
		WT3	14:15 - 14:40
			14:40 - 15:05
			15:05 - 15:30
			15:30 - 15:55
			15:55 - 16:20
			16:20 - 16:45
	Closing		17:00-19:00

Important Notes

Teams

All Rounds

Code:	Teams	TBM1	TBM2	TBM3	FBM1	FBM2
WT1	b-it-bots					
WT2	IASLab					
WT3	SPQR					
	Total:	2	2	2	2	2

Round 1:

Code:	Teams	TBM1	TBM2	TBM3	FBM1	FBM2	FBM3
HT1	b-it-bots						
HT2	BARC						
HT3	Donaxi						
HT4	homer						
HT5	Pumas						
HT6	SocRob						
HT7	Ursus						
HT8	Watermelon						
	Total:	7	8	7	7	6	8

TBA	**Denotes: To Be Announced.** After each round, the best teams in each TBM & FBM will pass to the next round. The selection of the occupation slots will be assigned by TC-OC members, taking into account teams participations in others TBMs & FBMs.

Legend

	TBMs@Home
	FBMs@Home
	TBMs@Work
	FBMs@Work
	Will participate
	Will not participate

Map of Cité

LES EXPOSITIONS
EXHIBITIONS / LAS EXPOSICIONES

Niv 2
Level / Planta

Observatoire de l'univers
Observatory / Observatorio

Niv 1
Level / Planta

Pôle météo
Weather centre / Polo meteorología

Vaisseau terre
Spaceship earth / Nave tierra

Quai du système solaire
Solar system / Sistema solar

Niv 0
Level / Planta

Centre de lancement
Launch centre / Centro de lanzamiento

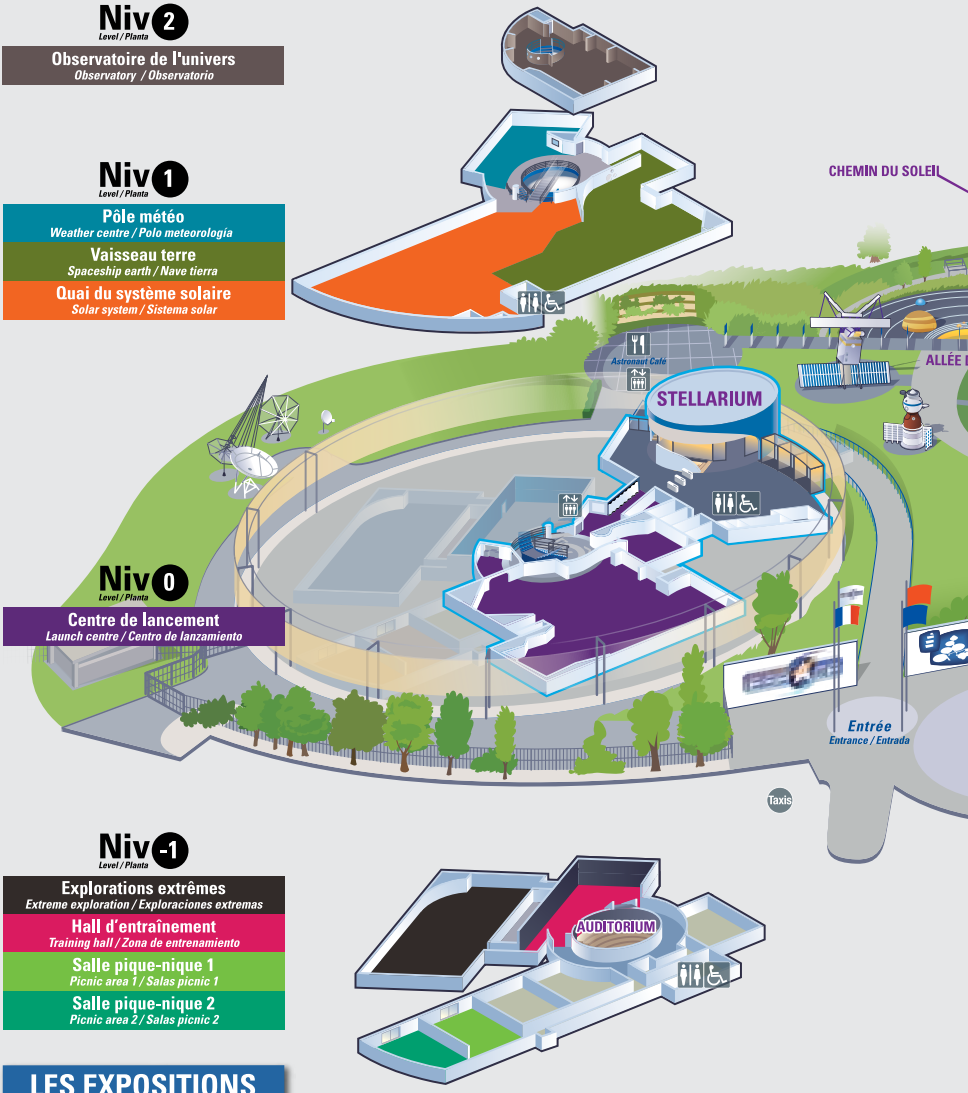
Niv -1
Level / Planta

Explorations extrêmes
Extreme exploration / Exploraciones extremas

Hall d'entraînement
Training hall / Zona de entrenamiento

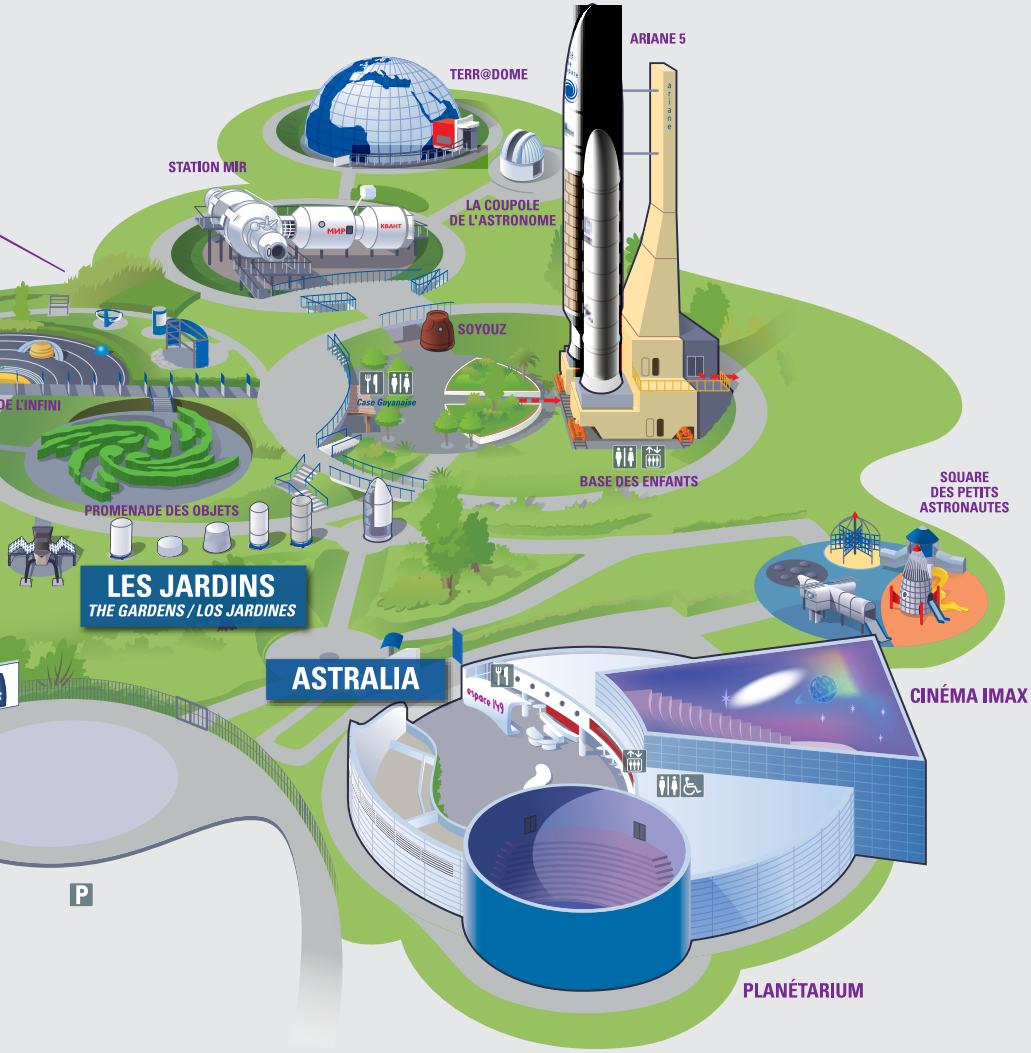
Salle pique-nique 1
Picnic area 1 / Salas picnic 1

Salle pique-nique 2
Picnic area 2 / Salas picnic 2



LES EXPOSITIONS
EXHIBITIONS / LAS EXPOSICIONES

de l'Espace


ARIANE 5
TERR@DOME
STATION MIR
LA COUPOLE
DE L'ASTRONOME
SOYOUZ
BASE DES ENFANTS
SQUARE
DES PETITS
ASTRONAUTES
PROMENADE DES OBJETS
LES JARDINS
THE GARDENS / LOS JARDINES
ASTRALIA
CINÉMA IMAX
PLANÉTARIUM
P

CONSORTIUM PARTNERS

SAPIENZA

Hochschule
Bonn-Rhein-Sieg

KUKA

INNOCENTIVE

USING

COMPETITIONS TO INNOVATE

FOR SMARTER

MORE DEPENDABLE ROBOTS

CONNECT WITH US

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RoCKIn

Robotic Competitions Kick Innovation in Cognitive Systems and Robotics