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TERRINet

The European Robotics
Research Infrastucture Network

Deliverable Number:	D2.1
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Summary

The deliverable describes the Robotics Research Infrastructures map and database with 104 platforms from all partners, which has been implemented and published on the TERRINet webpage[1] in December 2018.

Section 1.1 gives a brief overview on the Robotics Research Infrastructures map and its technical implementation and section 1.2 describes the TERRINet robotics platform database, associated functionality regarding searching for a specific platform and viewing the search results. Section 1.3 gives example descriptions of the platforms, which are also provided in the appendix. In section 1.4 we describe our future work regarding maintaining and extending the TERRINet robotics platform database.

[1] https://www.terrinet.eu

Chapter 1

The TERRINet Robotics Research Infrastructure

The Robotics Research Infrastructures map provides the various robotics platforms offered by the different TERRINet partners. To this end, we implemented a database which contains the platforms with their technical descriptions as well as possible research questions and/or applications which can be conducted with each of the platforms. In addition, we implemented an intuitive interface to the database which allows users to search for suitable platforms and display the associated information. **The database with** 104 **platform descriptions from all partners has been published on the TERRINet project website in December 2018.**

Technically, the database has been implemented as a Wordpress page located in a *MySQL* database and fully integrated in the project's webpage. The interface allows a keyword-based search for a certain platform (e. g. iCub, HRP, Soft arm, ARMAR) or a research topic (e. g. grasping, driving, learning, simulation, medical robotics, etc.). The search results are then displayed to the user who can then navigate to detailed information of a platform.

1.1 Robotics Research Infrastructures Map

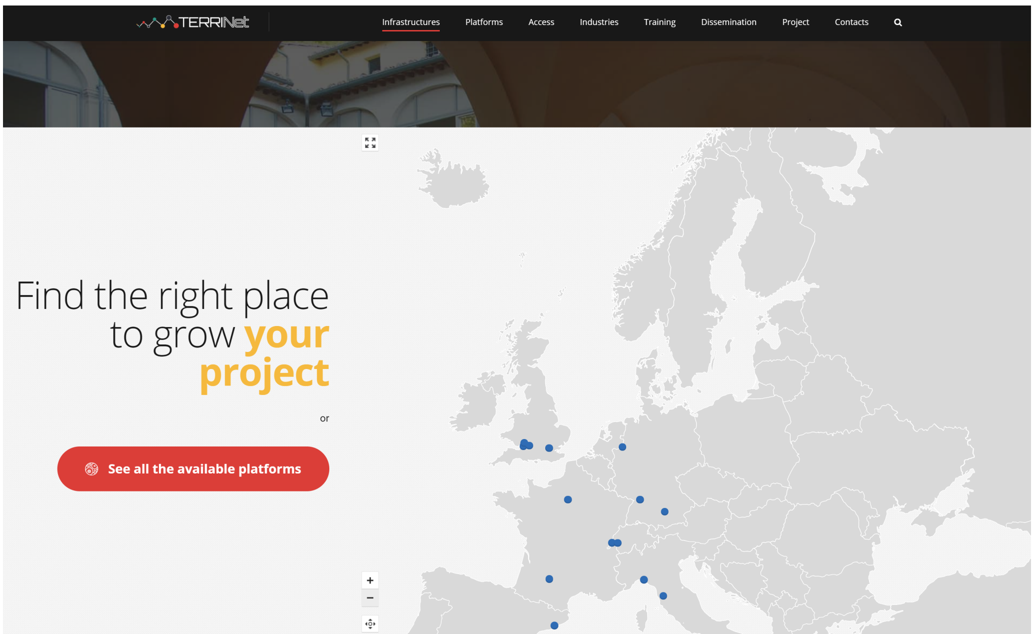


Figure 1.1: The interactive map of the TERRINet Robotics Research Infrastructure.

Figure 1.1 shows the Robotics Research Infrastructures map as shown at the TERRINet homepage. It uses a scalable vector graphic to display a map of Europe and blue markers to visualize the locations of TERRINet partners and infrastructures. The markers are linked to infrastructures and, when clicked, a popup window will open with further information about the infrastructure, including the name of the organisation, laboratory and its logo. The popup window contains also a link to the infrastructure page of the TERRINet webpage. This infrastructure page contains detailed information about the laboratory, contact persons and all its offered platforms. The map is created using the Wordpress plugin *Mapplic*. It offers an easy way to insert new or modify existing infrastructure-markers to the map without any programming skills and to link them to specific infrastructure pages.

1.2 The TERRINet Robotics Platfrom Database

The database contain 104 platforms from all partners. A list of the platforms is show on the webpage where the entries are ordered by the names of the robotic platforms in ascending order. An entry for a specific platform is described by the following attributes:

1. **Image:** An image of the robotic platform, so that end-users get a visual expression of the platform
2. **Lab name:** The name of its laboratory and its organization
3. **Platform name:** The name of the robotic platform
4. **Description:** A short description of the platform
5. **Link:** A hyperlink to the infrastructure page with more information about the platform. The infrastructure page contains further information about key features, possible applications, technical specifications, responsible person, scientific papers related to the platform, videos or pictures.
6. **keywords:** A list of keywords related to research topics, potential application, software framework, interfaces, etc.

Figure 1.2 shows an example entry of the database showing the humanoid robot ARMAR-III. On the top, the search window is shown. The numbers in the figure correspond to the attributes described above.

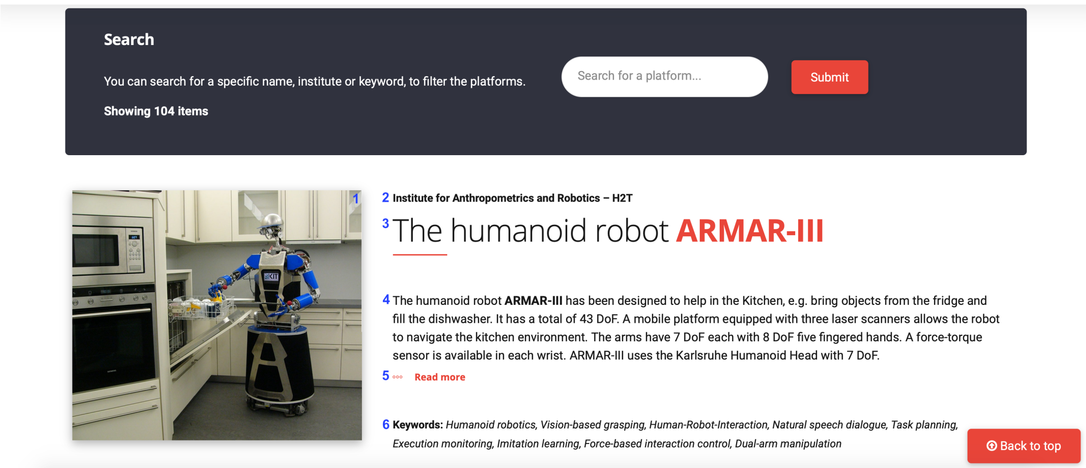


Figure 1.2: An example of the database showing the humanoid robot ARMAR-III. On the top, the search window is shown. The numbers in the figure correspond to the attributes described above.

The search window allow specifying search queries, which consist of keywords or sequences of keywords as strings combined by the logical operators AND and OR. Further, the search windows provides suggestions for possible keywords, based on a list of keyword, which has been automatically extracted from all platform descriptions (see fig. 1.3).

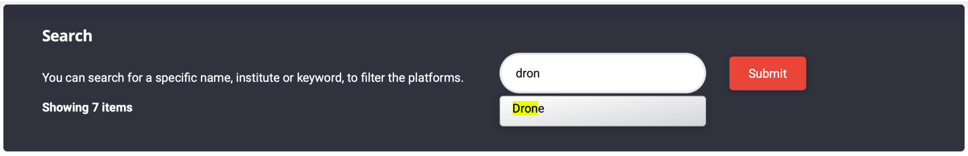


Figure 1.3: An example of a search suggestion

1.3 Platform Descriptions

Descriptions of 15 platforms (one from every partner) are given in the appendix (see chapter 2) to this deliverable.

1.4 Future Work

This deliverable presents the initial version of the map, the infrastructures and the corresponding robotic platforms. The map, database and its interface, the platform list and the technical description are subject to continuous update to reflect changes.

We will extend the attributes describing the platforms to provide information related to research activities and tasks performed on the different platforms during the project.

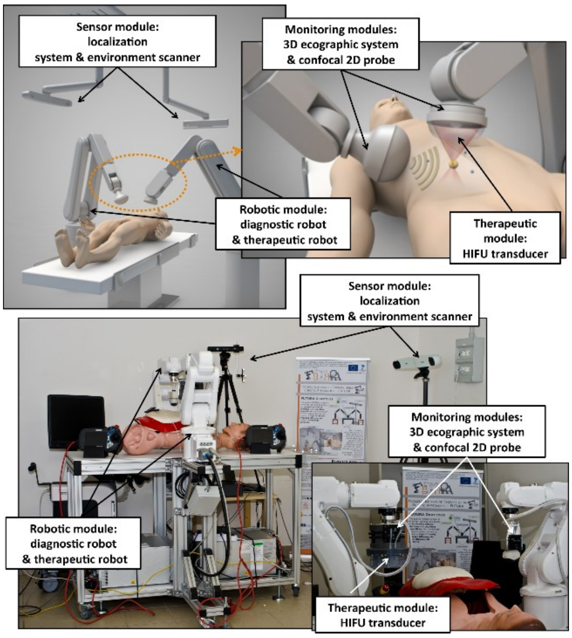
Chapter 2

Appendix

This appendix contains descriptions of exemplary 15 platforms (one from every partner). These are:

1. FUTURA platform for US-guided HIFU treatment, SSSA - The BioRobotics Institute
2. TX90 Staubli, CEA - Interactive Robotics Lab
3. Aerial Robots in a flight arena, CNRS - The Robotics Department of LAAS
4. ARMAR-6, KIT - IAR, H2T
5. Cooperative Robotic Manufacturing Station, TUM - Robotics and Embedded Systems
6. The iCub robot, IIT - iCub Facility
7. LOPES, RAM - Department of Robotics
8. Tibi and Dabo robots, UPC - IRI
9. Darius, Universidad de Sevilla - Robotics, Vision and Control Group
10. Onchilla, EPFL - Biorobotics Laboratory
11. eBee, EPFL - Laboratory of Intelligent System
12. Assisted Living Studio, UWE Bristol - Ambient Assisted Living Laboratory
13. ABB IRB 120, UWE Bristol - Bristol Robotics Laboratory
14. KUKA KR60-3, UWE Bristol - Bristol Innovation Facility
15. Imina MiBot, ICL - The Hamlyn Centre

A complete description of each platform is given on the following pages.

Name of the platform	**FUTURA platform for US-guided HIFU treatment**
Name of the Infrastructure	The BioRobotics Institute, Scuola Superiore Sant'Anna
Location	Pontedera, Italy
Unit of access	Working day
	The FUTURA system is a robotic-assisted platform designed for Ultrasound-guided High Intensity Focused Ultrasound (HIFU) treatment. The control of two independent anthropomorphic manipulators provides the FUTURA platform with high flexibility in terms of operating workspace and maneuverability. The platform is composed of: i) a robotic module, ii) a therapeutic module, and iii) a monitoring module. The *robotic module* is composed by two anthropomorphic industrial manipulators (i.e., ABB IRB 120) equipped with two force/torque sensors (ATI mini 45). The *monitoring module* is composed by two different US probes: i) a 2D imaging US probe (Analogic Ultrasound PA7-4/12) confocal to the HIFU transducer, and ii) a motorized 3D imaging US probe (Analogic Ultrasound 4DC7-3/40) mounted on the second manipulator, both connected to the Analogic Ultrasound SonixTablet machine. The *therapeutic module* consists of a custom-made Focused Ultrasound System. This system has three main components: i) a multi-channel high power signal generator (Image Guided Therapy), ii) a 16 channels phased annular array transducer (Imasonic), and iii) a coupling system (small pillow filled with water) which provides a good acoustic path between the transducer and the patient. The remote control on the FUS generator allows to adjusts the shooting parameters (e.g. focal depth) with a frequency of 20 Hz. The different modules of the FUTURA platform are mutually controlled through dedicated software developed in Robot Operating System (ROS) framework. The FUS treatment is managed by the users through a dedicated Human Machine Interface with real-time visualization of the working scenario. The high modularity of the platform allows for the testing of different modalities: specific experiments dedicated to image guidance, force controlled contact with human tissues, obstacle avoidance strategies between manipulators and patients/operators can be also set-up in the framework of the overall structure.
Key features • Robotic HIFU treatment under US guidance – no invasive intervention	

- Modularity
- High flexibility in terms of operating workspace and manoeuvrability
- HIFU therapy delivery in a range of distance from 10 to 130 mm from the patient's skin
- Control strategy for organ breathing compensation
- Safety strategy

Possible applications

- Robotic HIFU treatment characterization
- Motion compensation strategy
- Machine learning
- Computer vision techniques
- US and FUS phantom realization and testing

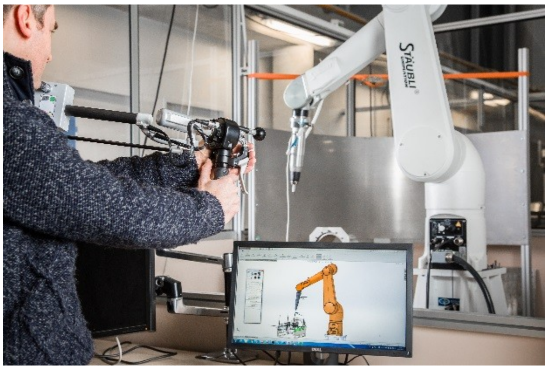
Technical specifications in brief

Robotic components	2 ABB robotic arms, i.e. 6 DoFs each
Control strategy	Machine learning and computer vision techniques
HIFU system	16 channels custom annular array HIFU transducer ▪ optimal frequency: 1.2 MHz ▪ radius of curvature: 120 mm ▪ power: 20 W per channel (320 W max) ▪ steering capability: ± 40 mm
US systems	2D imaging US probe - Analogic Ultrasound PA7-4/12 - confocal to the HIFU transducer motorized 3D imaging US probe - Analogic Ultrasound 4DC7-3/40
Precision	Final shooting accuracy < 1mm

Additional information available at:

-

Name of the platform	**TX90 Staubli**
Name of the Infrastructure	CEA RIF@Paris-Saclay
Location	Palaiseau
Unit of access	Working day



TX90 6-axis robot

The TX90 6-axis robot is an articulated arm with 6 axes for increased flexibility.
The spherical work envelope allows maximum utilization of cell workspace. It can also be mounted on the floor, wall or ceiling.

The fully enclosed structure (IP65) makes the robotic arm ideal for applications in harsh environments.

The TX90 6-axis robot has a maximum payload of 20 kg and a 1000 mm reach.

Key features

- Load capacity 7kg in the whole workspace
- Workspace radius 1m
- 6 axes

Possible applications

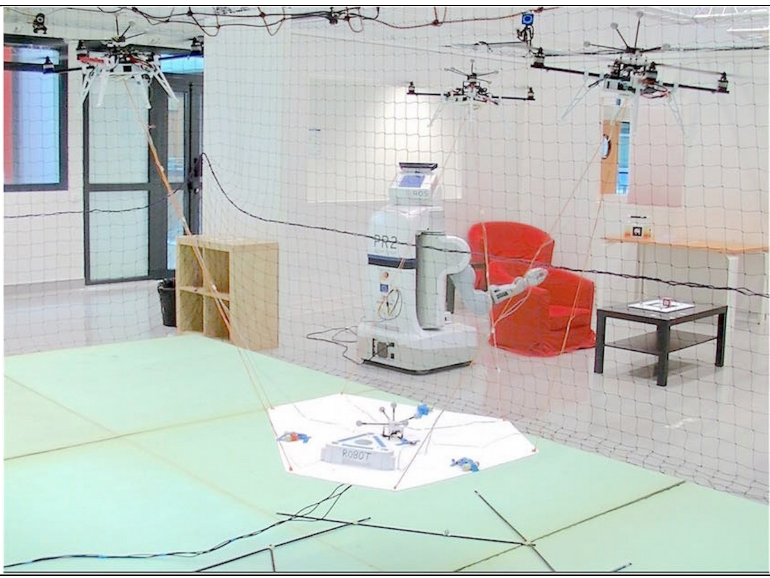
- Manufacturing tasks: polishing, grinding, assembly, etc.
- Robotics in harsh conditions and for hazardous environments
- Teleoperation

Technical specifications in brief

Interface	Internet
Load capacity	7kg
Degrees of Freedom	6
Protection (IEC 60529)	IP67
Repeatability	0,03mm

Additional information available at:
https://www.staubli.com/en-fr/robotics/product-range/6-axis-scara-picker-industrial-robots/6-axis-robots/tx90/

Name of the platform	**Aerial Robots in a flight arena**
Name of the Infrastructure	The Robotics Department of LAAS-CNRS
Location	Toulouse, France
Unit of access	Working day



Brief description of the platform

Several models of flying robots, as quadrotors and hexarotors aerial robots, in a delimited flight arena of 6mx4mx5m (l,w,h) enclosed by a protective net. The ground is covered by protective mattresses. The arena is equipped with a motion capture system.

Key features

- 6m length × 4m width × 5m height flying secure area enclosed by a protective net
- ground covered by protective mattresses
- 9 infrared cameras for motion tracking

Possible applications

- Multi-robot planning and control
- Aerial transportation
- Monitoring and mapping
- Aerial Manipulation
- Aerial Inspection

Additional example of applications may be found at http://homepages.laas.fr/afranchi/robotics/

Technical specifications in brief

Quad-rotors	Number: 4, Mass: 1.3 Kg, Diameter: 75cm
Hexa-rotors	Number: 2, Mass: 2 Kg ,Diameter: 115cm, Fully Actuated

Additional information available at:
https://www.laas.fr/public/en/robots-platform

Name of the platform	**Humanoid Robots: ARMAR-6**
Name of the infrastructure	IAR – H2T, KIT
Location	Karlsruhe, Germany
Unit of access	Working day
	**Brief description of the platform** ARMAR-6 is a collaborative humanoid robot assistant for industrial environments. Designed to recognize the need of help and to allow for an easy and safe human-robot interaction, the robot's comprehensive sensor setup includes various camera systems, torque sensors and systems for speech recognition. The dual arm system combines human-like kinematics with a payload of 10 kg which allows for dexterous and high-performant dual arm manipulation. In combination with its telescopic torso joint and a pair of underactuated five-finger hands, ARMAR-6 is able to grasp objects on the floor as well as to work in a height of 240 cm. The mobile platform includes holonomic wheels, battery packs and four high-end PCs for autonomous on-board data processing. The software architecture is implemented in ArmarX (https://armarx.humanoids.kit.edu). High-level functionality, like object localization, navigation, grasping and planning are already implemented and available.

Key features

- Dexterous arm system with 2x8 DoF for dual arm manipulation
- Underactuated five-finger hands
- Limitless rotation in shoulder, upper arm and forearm
- Comprehensive sensor setup, including:
  - Highly precise absolute position sensors, torque sensors, temperature sensors and IMU in each arm joint
  - 6D-force-torque sensors in the wrist
  - Laser scanners for navigation
  - Sensor head with two stereo vision systems (Roboception rc_visard 160 & 2 Flea 3.0) and a depth camera (Microsoft PrimeSense RGB-D)
- Various control modes enable the execution of precise and torque/force-controlled motions
- Holonomic movement of the mobile platform
- Control architecture with memory and attention system

Possible applications

- Dual arm manipulation
- Force and torque based control and interaction
- Gravity compensated torque control
- Task space impedance control
- Physical human-robot interaction

- Vision-based grasping and deep learning for grasping
- Imitation Learning, Programming by demonstration
- Semantic scene understanding and affordance extraction
- Human-robot interaction
- Natural speech dialog
- Cognitive robotics: learning multimodal representations, affordances
- AI: symbolic planning and execution monitoring

Technical specifications in brief

Degrees of freedom	27
Total height	192 cm
Arm span width	310 cm
Arm range	130 cm
Working height	0 cm - 240 cm
Payload (single arm)	10 kg (long range), 14 kg (mid range)
Weight	160 kg (without battery packs)
Platform speed	1 m/s
Computers	4 high-end PCs, 1 GPU
Robotic framework	ArmarX
Bus system	EtherCAT (100 Mbit/s)
Software	ArmarX https://armarx.humanoids.kit.edu

Additional information available at:
http://www.humanoids.kit.edu

Conference paper describing the dual arm system:
S. Rader, L. Kaul, H. Fischbach, N. Vahrenkamp and T. Asfour, *Design of a High-Performance Humanoid Dual Arm System with Inner Shoulder Joints*, IEEE/RAS International Conference on Humanoid Robots (Humanoids), pp. 523 - 529, 2016
https://ieeexplore.ieee.org/document/7803325/

Name of the platform	**Cooperative Robotic Manufacturing Station**
Name of the Infrastructure	Chair of Robotics and Embedded Systems Group, Department of Informatics, Technical University of Munich
Location	Munich, Germany
Unit of access	Working day
	**Brief description of the platform** The setup consists of several robotic arms (Staubli TX0 and TX90, 4X ABB IRB 120, KUKA LRB iiwa), end effectors (including human-robot interaction safe R800 gripper) and a mock-up of a collaborative manufacturing cell equipped with a tactile SAPARO floor. The environment can be easily configured to represent different variations of the manufacturing and robot manipulation scenarios involving both industrial robots and human operators. This installation is particularly useful for research on human-robot cooperation, multi-robot object manipulation, human tracking and detection for ensuring safety, etc. It provides unique opportunities to perform research in manipulative and collaborative robotics with bleeding edge robotic sensors (e.g. the SAPARO floor), and several different manipulators, including the human-safe ones (e.g. KUKA iiwa). As such, it is attractive not only for the research community but also for the industry (especially in the SME segment) which require innovative robotic solutions that are both flexible and safe for humans.

Key features

- Staubli TX0 and TX90 (details can be found here)
- 4 x ABB IRB 120 (details can be found here)
- KUKA LRB iiwa (details can be found here)
- KUKA R800 HRI safe gripper (details can be found here)
- SAPARO floor (details can be found here)
- Kinect RGB-D camera, a Hokuyp UTM-30LX-EW laser rangefinder (details can be found here) and other optical sensors available for tryout including the whole Intel Realsense family (ZR300, R100, SR300) (details can be found in here)

Possible applications

- Human-robot cooperation
- Multi-robot object manipulation
- Human tracking and detection for ensuring safety

Technical specifications in brief

Technical details about each component can be found in the given links above.

Additional information available at:

Name of the platform	**The iCub robot**
Name of the Infrastructure	The iCub robot, Istituto Italiano di Tecnologia
Location	Genoa, Italy
Unit of access	Working day

Brief description of the platform

The iCub is a humanoid robot designed to support research in embodied AI. At 104 cm tall, the iCub has the size of a five year old child. It can crawl on all fours, walk and sit up to manipulate objects. Its hands have been designed to support sophisticate manipulation skills. The iCub is distributed as Open Source following the GPL licenses. The entire design is available for download from the project's repositories (http://www.iCub.org). Four robots are available in the iCub Facility at the Istituto Italiano di Tecnologia. The iCub is one of the few platforms in the world with a sensitive full-body skin to deal with the physical interaction with the environment including possibly people.

Key features

- Height: 104cm
- Weight: 25kg – 29kg with battery
- Degrees of freedom: 53
- Sensors: cameras (2), microphones (2), joint encoders (76), inertial sensors (linear, angular, compass), capacitive tactile sensors (4000), 6-axis force/torque sensors (6)
- Middleware: YARP, ROS

Possible applications

- Study walking/whole-body control
- Vision – including stereoscopic vision, object recognition, visuo-tactile
- Human-Robot Interaction
- Artificial Intelligence
- Manipulation – 9 degree of freedom hands

Additional example of applications may be found https://github.com/robotology

Technical specifications in brief

Degrees of freedom (motors)	53
Interface	Ethernet
Power supply	48V/onboard battery
Weight	29kg (with battery)
Cameras	640x480 RGB @30fps
Max force at the hand	~1kg
Skin sensors	Capacitive, ~4000 sensing points
Legs	6 degrees of freedom

Arms	7 degrees of freedom
Hands	9 degrees of freedom
Head	7 degrees of freedom
Torso	3 degrees of freedom

Additional information available at:
https://www.iit.it/research/lines/iCub

Name of the platform	**LOPES**
Name of the Infrastructure	Department of Biomechanical Engineering, University of Twente
Location	Enschede, The Netherlands
Unit of access	ZH-131
	**Brief description of the platform** The LOPES can be used to assist patients (e.g. stroke, SCI) during walking or assess gait impairments. It has eight powered degrees of freedom (hip flexion/extension, hip abduction/aduction, knee flexion/extension, pelvis forward/backward and pelvis mediolateral). Other degrees of freedom are left free. The robot is attached with a minimal amount of clamps which results in a short donning and doffing time. It is admittance controlled and allows for control over the complete spectrum from low to high impedance. Kinematics and interaction forces are measured by the device and it can be easily combined with EMG measurements. It allows to test new controllers (e.g. for exoskeletons) or assessment algorithms in a safe environment.

Key features

- Admittance controlled: control from low to high impedance possible
- Integrated sensors to measure kinematics and interaction forces
- 8 powered degrees of freedom
- Short donning and doffing time
- Simulink development library, allowing easy integration of new control algorithms

Possible applications

- Gait training
- Gait assessment
- Human-Robot Interaction
- Controller development for exoskeletons
- Human-in-the-loop testing

Technical specifications in brief

See
Meuleman, J., van Asseldonk, E., Van Oort, G., Rietman, H., & van der Kooij, H. (2016). LOPES II-Design and Evaluation of an Admittance Controlled Gait Training Robot With Shadow-Leg Approach. IEEE Trans Neural Syst Rehabil Eng, 24(3), 352–363.

Donning time	5-15 minutes
Powered degrees of freedom	8
Other free degrees of freedom	9
Control	Admittance control
Maximal Torque (varying per joint)	60-66 Nm

Maximal rendered stiffness	1500 Nm/rad	

Additional information available at:
The design and control of LOPES is described in detail in the PhD thesis of Jos Meuleman
http://josmeuleman.nl/thesis.html
Information on LOPES related project can be found at
https://www.utwente.nl/en/et/be/research/projects/lopes

	Tibi and Dabo robots Institut de Robòtica i Informàtica Industrial, IRI, CSIC-UPC Barcelona, Spain
Name of the platform	Tibi and Dabo robots
Name of the Infrastructure	Institut de Robòtica i Informàtica Industrial IRI, CSIC-UPC
Location	Barcelona, Spain
Unit of access	Working day

Description

in

Tibi and Dabo are two mobile urban service robots aimed to perform navigation and human robot interaction tasks.

Navigation is based on the differential Segway RMP200 platform, able to work balancing mode, which is useful to overcome low slope ramps. Two 2D horizontal laser range sensors allow obstacle detection and localization.

Human robot interaction is achieved with two 2 degrees of freedom (dof) arms, a 3 dof head with some face expressions, a stereo camera, text-to-speech software and a touch screen.

They can be used to provide information, guiding and steward services to persons in urban spaces, either alone or both in collaboration.

Specifications

- Weight of about 100kg
- Dimensions: 60 (W) x 60 (L) x 160 (H) cm
- Battery with up to 3h operation time and 8h charge time.
- Differential mobile platform Segway RMP200, maximum speed ~1m/s
- Two laser Hokuyo UTM-30LX
- Two arms with 2 dof each, and one head with 3 dof.
- LED face expressions (mouth, eyebrows and cheeks)
- Stereo camera Bumblebee2 (placed on the head)
- Loquendo text-to-speech software with english, spanish and catalan languages
- Touch screen
- Onboard router for internal network with wi-fi and 3G connectivity
- Remote and onboard emergency stop buttons
- Two industrial onboard computers and an external laptop for monitoring
- ROS enabled robot

Applications - 2D navigation in urban environments - Human robot interaction - Multirobot systems - Teleoperation
Additional information http://wiki.iri.upc.edu/index.php/Tibi-Dabo

Name of the platform	**Darius**
Name of the Infrastructure	Robotic, Vision and Control Group, Universidad de Sevilla
Location	Sevilla, Spain
Unit of access	Working day

Brief description of the platform

Self-designed hexacopter, designed for being able to accomplish a variety of tasks. It can be controlled with two different types of autopilots: Pixhawk (Px4) and Naza V3. It can carry up to 8kg of payload, including robotic arms. It is also foldable.

Key features

- Weight: 7kg +8kg extra payload
- 12 minutes endurance (fully loaded)
- Diameter: 1.7m
- Foldable
- Motors: KDE6213XF (185Kw)

Possible applications

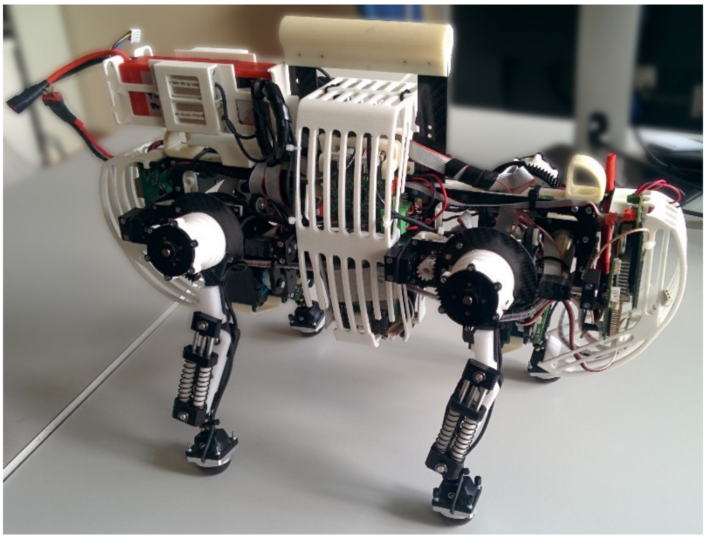
- Use of tools for aerial repairs
- Object grabbing in inaccessible locations
- Multipurpose aerial cooperation for structure assemble
- Obstacles detection and removal
- Load transportation

Technical specifications in brief

Weight	7kg
Interface	Ros/Ubuntu
Power supply	2 batteries 25-volt 12-amp
Altitude	2500 AMSL
Speed	17 m/s
Endurance	12 minutes (Fully loaded)
Height	550mm

IH2 Azzurra Hand
The BioRobotics Institute
Scuola Superiore Sant'Anna
Italy

Name of the platform	**Onchilla**
Name of the Infrastructure	Biorobotics Laboratory, EPFL
Location	Lausanne, Switzerland
Unit of access	Working day



Brief description of the platform

Oncilla is a compliant, quadruped robot developed during the FP7 European project AMARSi (Adaptive Modular Architectures for Rich Motor Skills, project start March 2010, project duration 48 months, 4 Oncilla copies build and distributed, 2 remain at BIOROB). The goal of the AMARSi project was to improve richness of robotic motor skills. Oncilla is a highly sensorized robot with panthographic legs (ASLP legs) as well as an abduction/adduction (AA) mechanism. The sensorization features encoders on each joint and motor, IMU as well as new ground contact sensors in the feet (3d force-sensors). The research done with the BIOROB team focuses around closed loop rough terrain locomotion and richer motor behaviors through a combination of CPG's and reflexes.

Key features

- Different actuator architecture using Brushlessh DC motors and custom electronics
- Closed-loop control with joint position and inverse kinematics
- Load sensors, IMU
- On-board power supply
- Possibility of up to 500g payload

Possible applications

- Animal gait exploration
- Platform for sensor carrier, such as camera
- Exploring different neural networks inspired by animals
- Researching different feet or legs designs
- Search and Rescue

Technical specifications in brief

Maximum speed, vmax	0.6 m/s
Froude number FR (v^2/G/lhip)	0.18
Body lengths per second	2.7
Gait type	trot/ bound/ walk
Active degrees of freedom	12
Mrobot	5.05 kg
Mactuators+electr, sum	2.845 kg
lhip, standing height	0.201m
dshoulder-shoulder	0.138m
dhip-shoulder	0.223m
RC servo motor	Kondo KRS2350 ICS (4x)

	Maxon 90 BLDC (8x)
Control board	RoBoard RB110
Power supply, tethered	10V to 12V

Additional information available at:
https://biorob.epfl.ch/op/edit/amarsi
Videos: https://go.epfl.ch/ExperimentsOncilla
3DPDF: https://go.epfl.ch/3DPDFOncilla

Name of the platform	**eBee drone**
Name of the Infrastructure	Laboratory of Intelligent System, EPFL
Location	Lausanne, Switzerland
Unit of access	Working day

Brief description of the platform

The senseFly's eBee is a fully autonomous and easy-to-use mapping drone. Use it to capture high-resolution aerial photos you can transform into accurate orthomosaics (maps) & 3D models. The eBee package contains all you need to start mapping: RGB camera, batteries, radio modem and eMotion software.

Key features

- Ultra-portable fixed-wing with a carry case
- Hand launch
- Automatic piloting and landing

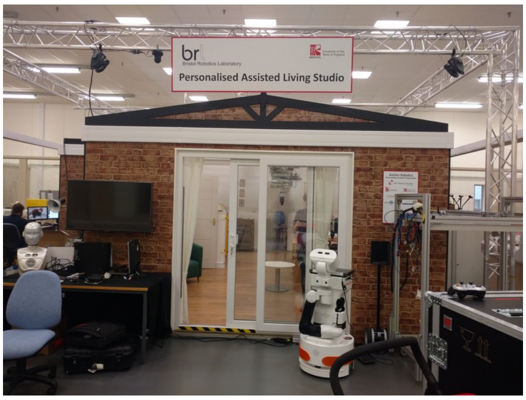
Possible applications

- Collaborative navigation of aerial and land robots
- Search and rescue missions
- Precise mapping and 3D model creation
- Agriculture

Technical specifications in brief

Wingspan	96cm
Weight (incl. supplied camera & battery)	Approx. 0.69 kg
Radio link range	3 km nominal (up to 8 km)
Cameras (supplied)	senseFly S.O.D.A. (1" 20Mpix sensor)
Cruise speed	*40-90 km/h (11-25 m/s)*
Wind resistance	*Up to 45 km/h (12 m/s)*
Max. flight range	*33 km*
Landing	*Automatic, linear with ~5 m accuracy*
Max. flight time	*50 minutes*

Additional information available at:
https://www.sensefly.com/drone/ebee-mapping-drone/

Name of the platform	**BRL – Assisted Living Studio**
Name of the Infrastructure	Bristol Robotics Laboratory-RIF
Location	University of West of England Bristol, United Kingdom
Unit of access	Working day
	**Brief description of the platform** Anchor Robotics Personalised Assisted Living Studio is an in-house facility to develop, test and implement assistive robots and heterogeneous sensor systems in a realistic environment, bringing together our expertise in robotics, human-robot interaction, intelligent learning systems and person-centred design. This helps to ensure real-world applicability of our research and can help in reducing the time to get these innovative technologies to market.

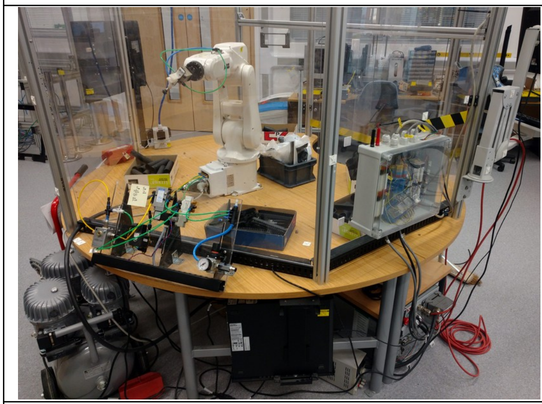
Key features

- Sensors
- Cameras
- Safety monitoring measures

Possible applications

- Observation of Human Robot Interaction
- Development of Sensory System for Human Behaviour Monitoring
- Implementation of Cloud Computing for Human Observations
- Development of Aids for Human Functionality

Additional information available at:
http://www.brl.ac.uk/research/researchthemes/assistedliving.aspx
http://www2.uwe.ac.uk/faculties/FET/Research/Bristol_Robotics_Laboratory/20160919%20-%20ConnectedAssistiveRoboticsFlyer.pdf

Name of the platform	**ABB IRB 120**
Name of the Infrastructure	Bristol Robotics Laboratory-RIF
Location	University of West of England Bristol, United Kingdom
Unit of access	Working day
	**Brief description of the platform** Flexible 6-axis industrial robot, with a payload of 3 kg, designed specifically for manufacturing industries that use robot-based automation. 3 robots available, with compact IRC5, RobotWare and RobotStudio available. 3D camera available for bin picking and part location. Flexible and with high speed. The presence of a cage or additional safety systems is required. High repeatability and speed, medium-low load capacity. 16/16 I/Os with 24V, 1 A power supply, and 5 MPa pneumatic air supply.

Key features

- Maximum load capacity: 3 kg
- Position repeatability: ±0.01 mm; accuracy: ±0.02 mm
- Programmable via RAPID on HMI pendant or Robotstudio
- DeviceNet, PROFIBUS adapter, Ethernet/IP, Allen-Bradley Remote I/O, PROFINET

Possible applications

- Light Weight Pick and Place
- Complex Sensor Driven Robot Control
- Robot+Vision System Interfacing
- Robot Cell Design
- Robot-robot collaboration studies

Technical specifications in brief

DoA	6
Interfaces	Various
Power supply	N/A
Weight	N/A
Load	3 kg

Additional information available at:
http://search.abb.com/library/Download.aspx?DocumentID=ROB0295EN&LanguageCode=en&DocumentPartId=&Action=Launch

https://library.e.abb.com/public/1e22e4c2c6e647619b6d0bcda4a1a8fc/3HAC035960-en.pdf

Name of the platform	**KUKA KR60-3**
Name of the Infrastructure	Bristol Robotics Laboratory-RIF
Location	University of West of England Bristol, United Kingdom
Unit of access	Working day

Brief description of the platform

Six-axis industrial grade robot arm. Flexible and versatile, with high repeatability, medium load capacity and high speed, high duty cycles.
EtherCAT communication (Industrial Ethernet), Profisafe, Backhoff 32/32 digital I/Os at 24 VDC and 4-channel outputs at 24 VDC, 2 A.

Key features

- Maximum total load: 65 kg
- Maximum reach: 2429 mm
- Position repeatability: ±0.06 mm
- Programmable via KRL (Kuka Robot Language) on HMI pendant or WorkVisual

Possible applications

- Handling of materials, tools and other machines
- Measuring, testing and inspection
- Machining and manufacturing processes
- Packaging

Technical specifications in brief

DoA	6
Interface	EtherCAT
Power supply	N/A
Weight	N/A
Load	30 Kg
Maximum total payload	65 Kg

Additional information available at:
https://www.kuka.com/-/media/kuka-downloads/imported/48ec812b1b2947898ac2598aff70abc0/spez_kr_30_60_ha_en.pdf

Name of the platform	Imina MiBot
Name of the Infrastructure	The Hamlyn Centre
Location	Imperial College London, The Hamlyn Centre, Bessemer Building, London
Unit of access	Working day
	**Brief description of the platform** The miBot uses piezo actuators with mobile motion technology that makes the miBot both extremely precise and very easy to control. Diverse micro-tools can be mounted on the miBot tool holder, which makes it particularly well-suited for R&D applications in material science, microelectronics and photonics, whenever in situ physical interactions with the sample are sought. The miBot manipulator is a mobile micro-robot. This means it moves directly over the surface of the base on which a sample lays and has no mounting screws. The manipulator can therefore be pre-positioned by hand, making it very fast to set-up and reconfigure. Moreover, no movements of the miBot manipulator are coupled. It makes it very intuitive to control, significantly reduces the time to achieve complex manipulation, and eliminates the risk of damaging samples.
Key features •	
Possible applications • Fibre and gripper alignment • High precision alignment • Force measurement • Micro robot assembly • Small scale mechanical testing	
Technical specifications in brief	
Additional information available at:	