

TIAGo[®]

TECHNICAL SPECIFICATIONS

Free simulation and tutorials at:
wiki.ros.org/Robots/TIAGo

GENERAL FEATURES

Height 110 - 145 cm
Weight 70 Kg
Footprint ø 54 cm

DEGREES OF FREEDOM (DoF)

Torso lift 1
Mobile base 2
Head 2
Arm 7
TOTAL 12
 (without end-effector)



CONFIGURATION	IRON	STEEL	TITANIUM
Mobile base	✓	✓	✓
Navigation laser	5.60m	5.60m	10m
Lifting torso	✓	✓	✓
Pan-tilt head	✓	✓	✓
7 DoF arm		✓	✓
End-effector		Parallel gripper	5 finger hand
Force/Torque sensor		Optional	✓
Touchscreen monitor	Optional		

* Upgrade kits available in order to evolve the Iron version to Steel or Titanium
 The robot's configuration may change without previous notice

<u>BODY</u>	Arm payload (at full extension)	3 kg (without end-effector)
	Arm reach	87 cm (without end-effector)
	Torso lift	35 cm
<u>MOBILE BASE</u>	Differential drive	✓
	Max. speed	1 m/s
	Operation environment	Indoor
<u>CONNECTIVITY</u>	Wireless connectivity	802.11 n/ac 2x2 Dual Band Wi-Fi Bluetooth 4.0
<u>ELECTRICAL FEATURES</u>	Battery 36V 20Ah	1 battery / 2 batteries
	Battery autonomy	4 - 5h / 8 - 10h
<u>SENSORS</u>	Base	Laser 5.6m / 10m / 25m range, rear sonars 3x1m range
	IMU (Base)	6 DoF
	Motors	Actuators current feedback
	Head	RGB-D camera
<u>AUDIO</u>	Speakers	1x 5 W audio speaker
	Microphone	2-microphone array with stereo output 50-8000 Hz
<u>COMPUTER</u>	CPU	Intel i5 / i7 Haswell
	RAM	4 GB / 16 GB
	SSD	256 GB / 512 GB
<u>SOFTWARE</u>	OS	Ubuntu LTS 64-bits, RT Preempt
	Open source middleware	ROS LTS
	Periodic updates/patches	✓
	Arm with	Position / velocity / effort control
<u>SUPPORT</u>	Training and maintenance	On demand
	Online helpdesk	✓
<u>EXTENSIBILITY</u>	Laptop tray	✓
	Mounting points	On head, laptop tray and mobile base
	USB ports	1x USB3, 1x USB2
	Ethernet ports	2x Gigabit
	Power supply	12V / 5A
<u>OPTIONALS</u>	End-effector	Hey5 hand / PAL gripper / Schunk WSG32 gripper
	Wrist sensor	6 axis Force/Torque sensor
	Fingertips sensors	Available with Schunk WSG32 gripper
	Dock Station	✓
	Touchscreen	✓



OPERATING SYSTEM

Ubuntu LTS 64-bits
 RT Preempt real-time framework



ROBOTICS MIDDLEWARE

Orocos
 ROS LTS



SIMULATION

Gazebo dynamic simulation and URDF model

TELEOPERATION

Joystick teleoperation:
 base, torso lifter, head and end-effector

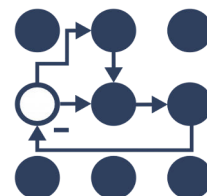


ROS CONTROLLERS

Controllers implemented as ros_control plugins running in the real-time control loop

Supported control modes:
 - Wheels: velocity control
 - Lifting torso and head: position control
 - Arm motors: position and effort mode

Joint trajectory controllers on groups of joints
 QT GUI to move individual joints
 Head Action Server to control the robot's gaze



UPPER BODY MOTION ENGINE

Path planning with self-collision avoidance
 10 pre-programmed motions
 Motions defined by the user

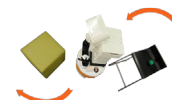
TEXT-TO-SPEECH

TTS software with one language and one voice



AUTONOMOUS NAVIGATION

Laser-based mapping and self-localization
 Navigation to a map point
 Obstacle avoidance



MOVEIT!

Off-the-shelf integration



ROBOT SENSORS VISUALIZATION

Rviz plugins for camera, lasers, sonars,
 IMU and force/torque sensor



WEB BASED INTERFACE

Robot actuators, sensors and software diagnosis
 Voice synthesis of sentences
 Execution of pre-recorded motions
 Execution of custom ROS commands



DEMOS

Current control: arm gravity compensation
 Arm movements by learning-by-demonstration
 Example of tabletop grasping

WHOLE BODY CONTROL

- Hierarchical quadratic solver providing:
- On-line inverse kinematics of the robot's upper body (7 DoF arm, torso prismatic joint, 2 DoF head)
 - Self-collision avoidance
 - Joint limit avoidance
 - Gaze control



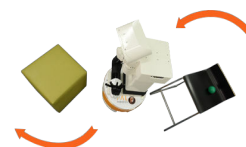
UPPER BODY TELEOPERATION

Teleoperation of the 7 DoF arm, the torso prismatic joint and the Hey5 hand/parallel gripper by using a Leap Motion* sensor**



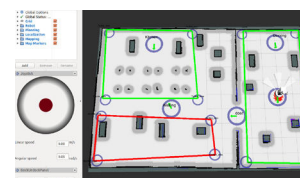
ADVANCED NAVIGATION

- Upgrade of the Autonomous Navigation Core package, including:
- Obstacle avoidance including the RGB-D camera
 - Navigation to points of interest or through a sequence of points of interest
 - Detection of regions of interest (topological localization)
 - Avoidance of **virtual obstacles** or forbidden regions



MAP EDITOR

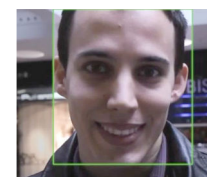
- Rviz plugin to easily:
- Download maps from the robot
 - Upload maps to the robot
 - Graphically add virtual obstacles, forbidden regions, points/regions of interest
 - Use graphical joystick to command robot base



FACIAL PERCEPTION

Face detection, matching, tracking and recognition of 6 basic emotions

Facial features identification (glasses, smile, open mouth, blinking)



AUTOMATIC SPEECH RECOGNITION

Off-the-shelf integration of Google's Cloud Speech API ROS interface providing ASR for over 80 languages and variants



TEXT-TO-SPEECH

Extra languages and voices



* Copyright © 2015, Leap Motion, Inc.

** The sensor is included with this option software.