

### GENERAL FEATURES

**Height**

120 - 150 cm

**Weight**

96 kg

**Footprint**

50 x 72 cm

**Max Autonomy**

8 - 10h

**Speed**

1.5 m/s

**Arm DoF**

2x 7

## TIAGo Pro

### Next Generation of Mobile Manipulators

Achieve accuracy and compliance with the enhanced manipulation capabilities of the torque-controlled arms. Tackle complex tasks with ease thanks to the user-friendly interface. Experience the power of seamless interaction, optimal arm mounting, and increased reach in a compact and modular design. Engage in Human-Robot Interaction thanks to the new design with LEDs, screen, and RGB-D camera.



### CONFIGURATION

Omnidirectional drive	✓
Navigation laser	2x 10m LIDAR (25m optional) Front and back for 360° FoV
Lifting torso	✓
Pan-tilt head	✓
End-effectors	2x Parallel Grippers
Force/Torque sensors	Optional in tool flange
Arm Joint Brakes	✓
Joint Torque Control	Series Elastic Actuators



# TIA Go<sup>®</sup> Pro

## TECHNICAL SPECIFICATIONS

<b>UPPER BODY</b>	Arm payload	3kg	
	Arm reach	96 cm	
	Torso lift	35 cm	
	Arm Mounting flange	ISO 9409-1	
<b>MOBILE BASE</b>	Omnidirectional Drive	4x Meccanum Wheels	
	Max speed	1.5 m/s <i>All directions</i>	
	Operational environment	Indoor	
<b>CONNECTIVITY</b>	Ethercat Bus	1 KHz	
	Wifi	802.11ax Wi-Fi 6	
	Bluetooth	Smart 4.0	
<b>ELECTRICAL FEATURES</b>	Battery 36V 20Ah	1 battery / 2 batteries	
	Battery autonomy	4-5 h / 8-10 h	
<b>SENSORS</b>	Base	2x 10m LIDAR (25m optional) <i>Front and back for 360° FoV</i>	
	Torque Sensors	Series elastic elements in all joints	
	Head	RGB-D camera	
<b>AUDIO</b>	Speakers	8W Stereo	
	Microphone	4x Microphone array	
<b>COMPUTER</b>	CPU	Intel i5 / i7	
	RAM	8 GB / 16 GB	
	SSD	250 GB / 500 GB	
<b>SOFTWARE</b>	OS	Ubuntu LTS 64-bits, RT Preempt	
	Open source middleware	ROS LTS	
	Arm joint control	Position / Velocity / Current / Torque / Impedance	
<b>INTEGRATED</b>	Laptop tray	✓	
	Upper body motions	10 pre-programmed	
	Joystick teleoperations	✓	
	Interactive face for HRI	Speakers	
		Microphones	
		Programmable LEDs	
		Emotion personalisation <i>Face screen</i>	
	User panel	On/Off Button & Battery Indicator	
	Ports	1x GbE / 2x USB 3 / 1x HDMI	
Power supply	12V / 5A		
Emergency button	✓		
<b>OPTIONALS</b>	GPU	NVIDIA Jetson AGX Orin	
	Camera	RGB-D <i>on the wrist</i>	
	Wrist sensor	6 axis Force/Torque sensor	

## CORE SOFTWARE

**Operating system** Ubuntu LTS 64-bit  
RT Preempt RT framework

**Middleware** Orocos  
Robot Operating System (ROS) LTS

## USER INTERFACES

**Web Commander** Diagnosis of software, actuators and sensors  
Text-to-speech triggering  
Execution of pre-recorded motions  
Execution of demonstrations

**Joystick teleoperation** Mobile base control  
Head control  
Torso lift control  
Execution of pre-recorded motions

## NAVIGATION

**Core Navigation package** Laser based self-localization and mapping (SLAM)  
Navigation to a point of a map  
Obstacle avoidance using laser sensors  
Available RViZ Plugin to navigation to a point in a map

## HUMAN-ROBOT INTERACTION

**Text-to-speech** TTS software with one language and one voice  
Triggered via Web-Based robot interface

**Robot Sensor visualization** Available RViZ Plugins for camera, lasers and sonars  
Available RViZ Plugins for IMU and Force/Torque sensors

## CONTROL

### ros\_control

Full ros\_control compatibility  
Hardware-agnostic controller written as ros\_control plugins  
Point level control in position, velocity, effort and torque  
Supported hardware interfaces: position, effort and torque

### ros\_controllers

#### Joint trajectory controller (default):

Command joint-wise trajectories to groups of joints  
(arm, head and torso)

### Default stack of controllers

Command individual joints  
Available QT-based GUI

#### Gravity compensation controller:

Arm position maintained compensating gravity  
Compliant behaviour of the arm

#### Differential drive controller:

Velocity-based controller for the mobile base  
Available RViz Plugin to navigation to a point in a map

### Upper body motions

#### play\_motion

Pre-recorded motions handling  
Allows execution with planning and self-collision avoidance

#### play\_motion\_builder

Generation of pre-recorded motions  
Available QT-based GUI

#### Movelt!

Fully integration that works off-the-shelf  
Motion generation with path planning and self-collision avoidance

#### Available RViz Plugins



## CONTROL

### Kinematic & Dynamic Whole Body Control Package

#### Controller based on a quadratic solver that solves a hierarchical set of tasks

Provides on-line inverse kinematics (resp. dynamics) of the robot's upper body (arm, torso, head)

#### Default stack of tasks contains:

Self-collision avoidance  
Joint limit avoidance

#### Allows for:

Cartesian Gaze control  
Cartesian control of end-effector  
Admittance compliant control (if there is F/T sensor)  
Joint space control of upper body  
Compliant behaviour of the arm

### Visual Programming Package

Intuitively programming the robot with a block based drag-and-drop graphical interface based on behaviour trees

Monitor robot's state and diagnostics in real time, including current status of: battery, network, volume, and emergency button, navigation mode

Easy access to pre-recorded motions and speeches

Creation of buttons that trigger robot motions or speech

## NAVIGATION

### Advanced Navigation Package

Obstacle avoidance using RGB-D head camera

Navigation to points of interest (PoI) or through a sequence of PoI

Detection of zones of interest (ZoI) (topological localization)

Avoidance of virtual obstacles / forbidden regions

#### Map Editor:

Download / Upload maps in the robot

Add virtual obstacles, forbidden regions, PoI, ZoI

Graphical joystick to control the robot in the map

## HUMAN-ROBOT INTERACTION

### Text-to-speech

Add extra languages and voices

### Facial Perception Package

Face detection, face matching, face tracking  
Recognition of 6 basic emotions  
Recognition of Facial features

### Automatic Speech Recognition Package

Google Cloud Speech API off-the-shelf integration  
Provides ASR for over 125 languages and variants

### Animation Interface Package

Creation and edit of new motions with the arm, head, and torso:

- Arm, head, and torso: Joint by joint via sliders
- Arm: moving the robot manually in gravity compensation mode

Building new presentations that combine robot speech, and motions

Monitor the robot's state and diagnostics in real time, including current status of: battery, network, volume, and emergency button, navigation mode

Easy access to pre-recorded motions and speeches

Creation of buttons that trigger robot motions or speech

### Advanced Grasping Package

#### Perform complex grasping tasks combining behaviour trees and MoveIt!

Based on server-client structure implemented with ROS Actions, using action servers:

- Perception server
- Grasp server
- Place server
- Custom servers

Detect objects based on basic shapes and colour

Customisation of parameters:

- Grasp candidate
- Object detection

General configuration (behaviour trees and actions)

Two out-of-the-box demos:

- Stack cubes
- Clear table