

# Manipulator Research Platform: Torobo Arm

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## 1. Background

In the present manufacturing factories, collaborative robots and robots that can achieve not only position control but also force control are required. However, there are few research platforms that can be used to develop those robots. Particularly, it is difficult to achieve the force control by using a ready-made industrial robot because its controller is a black box, although its stiffness and toughness are sufficient. On the other hand, many robots provided for robotics research have low stiffness and large backlash; accordingly, they cannot be applied to actual tasks. In order to overcome this problem, we developed the “Torobo Arm,” which has a performance equivalent to standard industrial robots and whose control system can be modified at a low level by providing the specification of the controller and its source code.

## 2. Torobo Arm

An overview of Torobo Arm system is shown in Fig. 1. This arm is easy to use for robotics research because it has the following features:



Fig.1 Torobo Arm system

### I. Torque sensor for each joint

Because all of its joints have torque sensors, Torobo Arm enables softer external force following/force control and safer contact detection, compared to the conventional current-based torque sensing method.

### II. Source code provided

Torobo Arm comes with the source code of the master controller (servo controller; C language) and PC (host controller; C#/Python). The robot control system can be customized from low-level control (such as torque control) to high-level control (such as path control).

### III. Connectivity to external systems

Because Torobo Arm is ROS-compatible, it is easily connected to other ROS-based systems. Torobo Arm can also connect to major kinematics simulators such as V-REP, ROS/MoveIt!, and Matlab/Robotics System Toolbox.

### IV. Small controller and DC24V-driven

Because the servo controller is small and driven by 24V DC, Torobo Arm is easy to be used in laboratories and also for mobile robots.

Another advantage of Torobo Arm is that all the parts but the motors and machined metal parts are designed and manufactured in Tokyo Robotics. For this reason, the arm is compact as an integrated system and customizable.

## 3. Sales

We started selling Torobo Arm from June 2016, and have sold fifteen units so far to universities, public research institutes, large private companies, and research oriented startups. From 2017, we will sell them internationally and develop a dual arm robot based on Torobo Arm.