Hands-on Lab

XL-320 Setup – Dynamixel Wizard Basics

This lab introduces the Robotis XL-320 Dynamixel servo and Dynamixel Wizard software. Specific concepts include: setting the servo's ID and baud rate; and commanding joint angles and wheel rotational speeds.

Preliminary: Dynamixel Wizard Installation

Robotis' XL-320 Dynamixel is a smart-servo; it features on-board memory and processor so that rotational angle and speeds can be accurately controlled. Robotis offers an ecosystem of smart-servos, servo controllers, and software integrated development environment (IDE). The Darwin-OP and Darwin-Mini are humanoids build on this ecosystem. RS-485 is used to communicate with Dynamixels, so other microprocessors and IDEs can be used. The first step however, is to become familiar with the Dynamixel Wizard to configure and calibrate one's XL-320.

Software Download

   A. Double-click the Dynamixel Wizard software installer (source:
       http://emanual.robotis.com/docs/en/software/dynamixel/dynamixel_wizard2/#software-installation)
   B. Follow instructions to install on one's computer

Hardware Connections
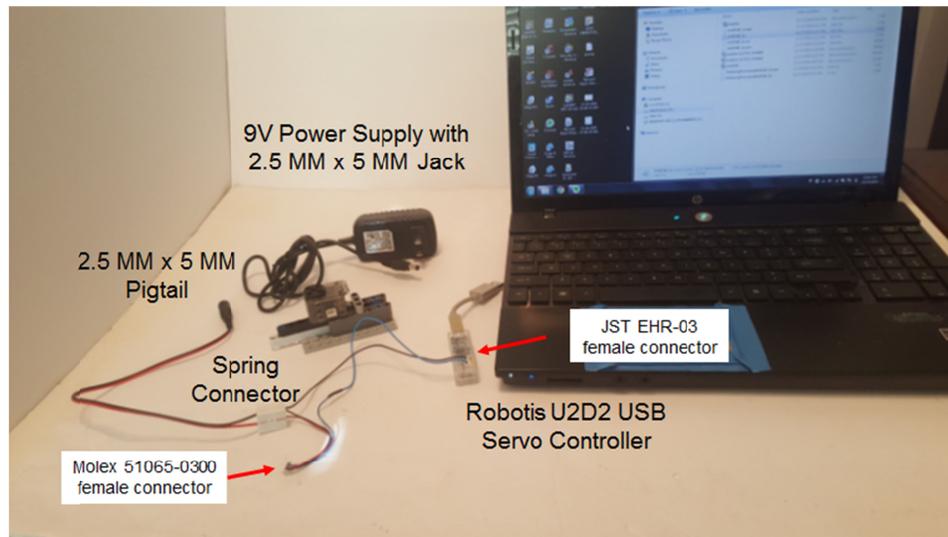
Figure A: Lego-based XL-320 Motor Mount and cabling

Figure A shows the various hardware components: a 9V wall wart is used to power the XL-320 servo. The pigtail allows the 9V and GND lines to connect to the Robotis U2D2 servo controller using a spring connector. The U2D2 is essentially a microprocessor that allows a computer (USB) to communicate to the XL-320.
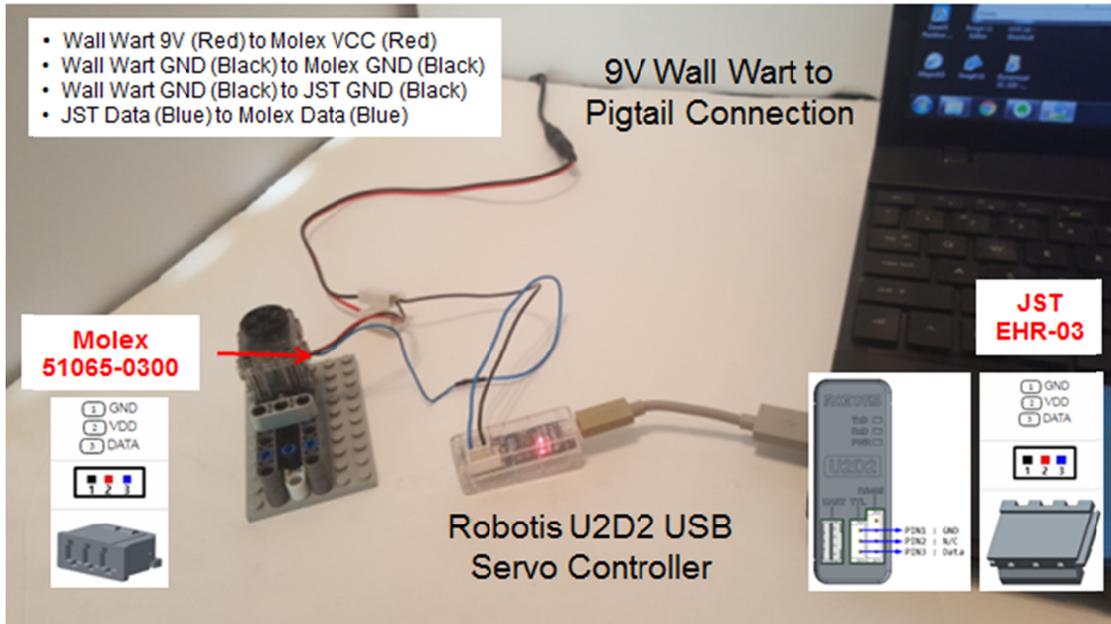
Figure B: Cable connections.

Figure B depicts the cable connections. First, tie the GND lines of the XL-320 (Molex connector), the U2D2 (JST connector) and the pigtail using a spring connector. Second, tie the pigtail's 9V line to the XL-320 VCC line via the spring connector. Lastly, make sure the data lines from the U2D2 and XL-320 are connected (blue wire).

Concept 1 – Setting Servo ID and Baudrate

Step 1: Launch the Dynamixel Wizard
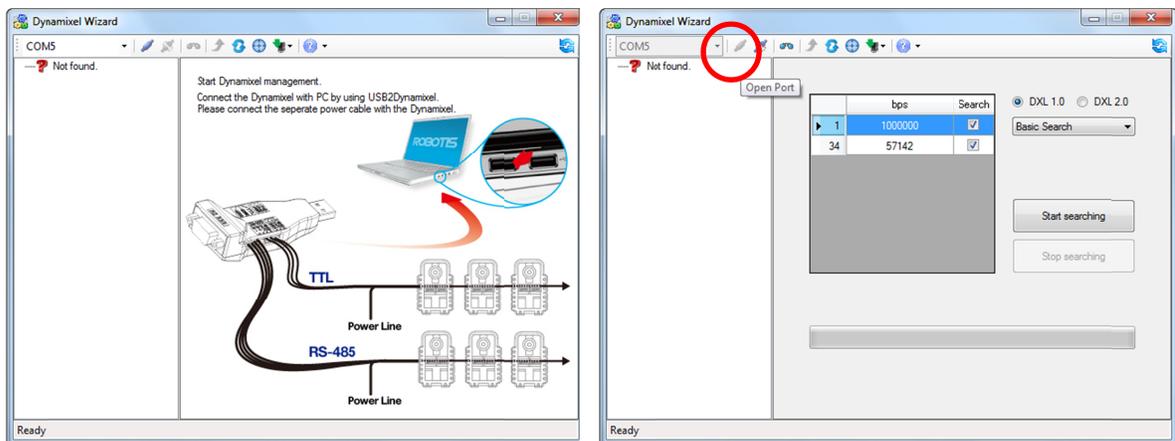
Figure 1-1 Dynamixel opening screen (left). Clicking `Open Port` (red circle) and pushing the `Start Searching` button requests a Dynamixel servo search (right).

The Dynamixel Wizard is used to setup Robotis servos. **Figure 1-1** (right) allows one to see what Dynamixel servos are connected to the PC's serial port.
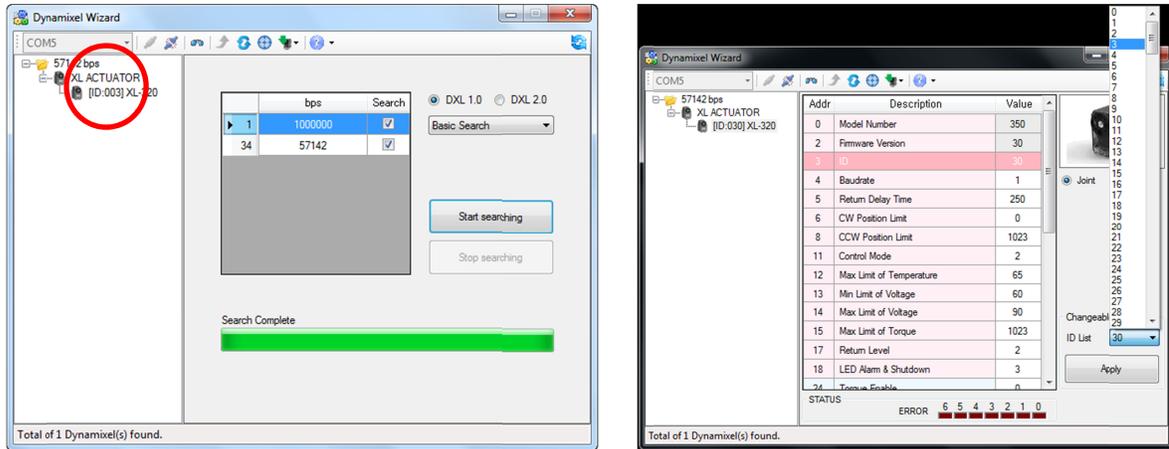
Figure 1-2: Results of the search reveals an XL-320 connected to the COM port (left). Clicking on the motor (red circle) reveals its current settings (right).

Step 2: Change XL-320 Servo ID

Figure 1-2 shows the properties of the XL-320 servo. Up to 253 different XL-320 servos can be daisy-chained; the servo ID allows one to uniquely identify each one. By default, the servo ID is the set to the label affixed to the XL-320.

For our future Lego NXC programming purposes, let us assign the XL-320 an ID of 1. Select `ID` and change to 1 and then press the `Apply Button`. This assigns the connected XL-320 with the ID of 1 (or 0x01 in Hexadecimal).

Step 3: Change Baudrate to 57600 bps

By default, factory XL-320 servos are set at a 1 Mbps baud rate. For our future Lego NXC programming purposes, change the baud to 57600.
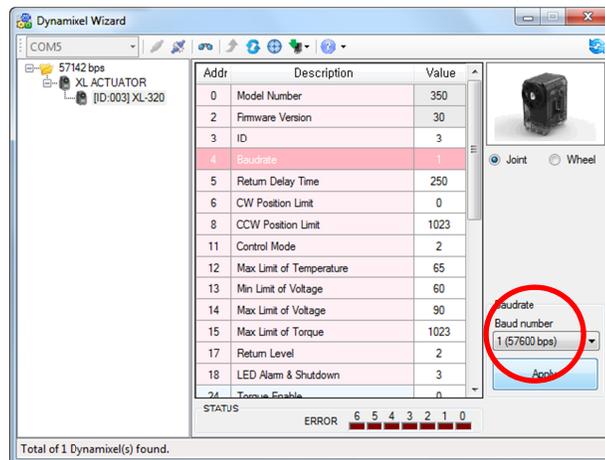
Figure 1-3: Clicking Baudrate allows one to change settings

Click the pull-down menu (**Figure 1-3** red circle), choose `57600 bps`, and push `Apply`.

Congratulations! You've set the XL-320 servo's ID and baudrate

Concept 2 – Command Angular Position (Joint Mode)

Dynamixel Wizard offers different modes to command the XL-320. In Joint Mode, one can command the XL-320 to desired angular positions.

Step 1: Enable Torque and Set Velocity
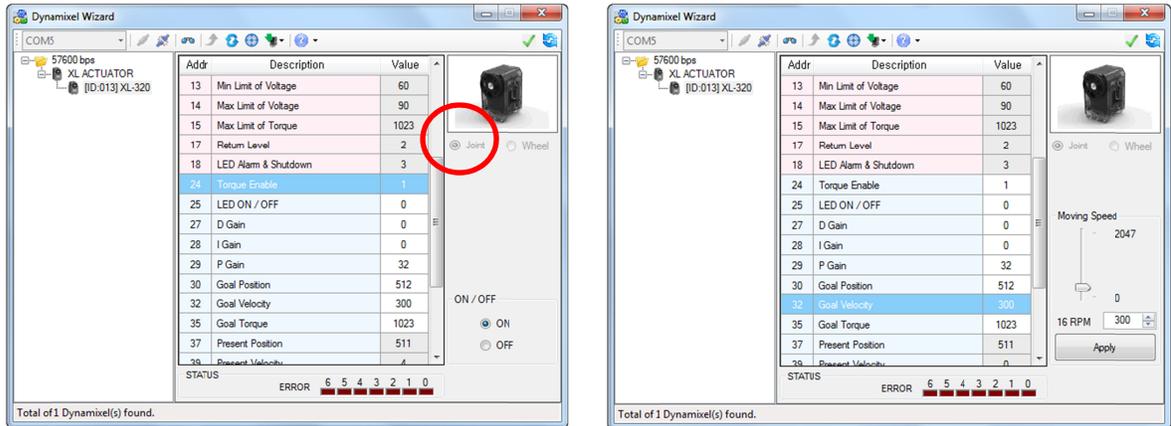
Figure 2-1: Selecting `Torque Enable` (left) shows options to turn torque detection `ON` or `OFF`. By default, torque is enabled and the motor is in Joint mode (red arrow). `Goal Velocity` sets the XL-320's rotational speed using the slider bar or typing values, and hitting the `Apply` button.

The XL-320 features over-torque protection. This is good to prevent damaging the servo. **Figure 2-1 (left)** shows that by default, `Torque Enable` is `ON`. The XL-320 can rotate very quickly and trigger over-torque protection. Thus, one can slow the servo's velocity; **Figure 2-1 (right)** shows `Goal Velocity` set to `300` once the `Apply` button is clicked.

Step 2: Command Angular Position
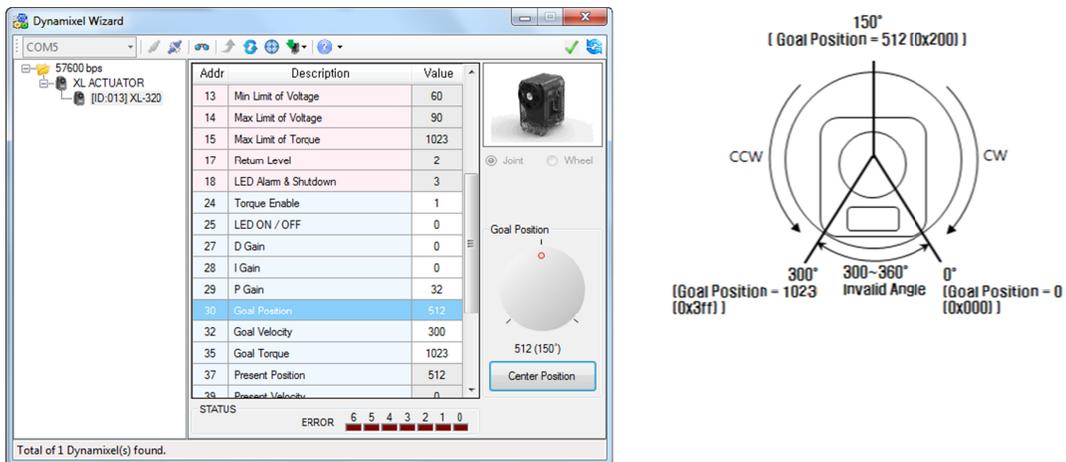
Figure 2-2: Goal Position (left) and corresponding degrees and direction (right)

Figure 2-2 shows `Goal Position`. Clicking `Center Position` will command the XL-320 servo to be the middle of its range (0 to 1023). Clicking-and-dragging the dial rotates the XL-320's horn.

Exercise 1:

1-1 What Goal Positions corresponds to the XL-320 being at its maximum clockwise and counter-clockwise positions?

1-2 What is resolution of the XL-320 servo in degrees? Hint: Maximum angular range is 300 degrees.

Concept 3 – Continuous Rotation (Wheel Mode)

In Wheel Mode, the XL-320's horn will rotate continuously.

Step 1: Disable Torque
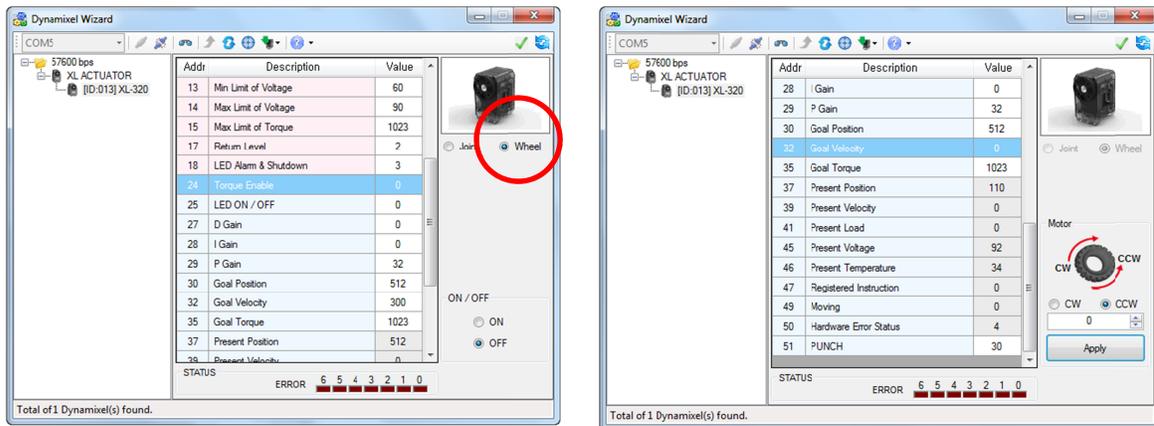
Figure 3-1: To rotate continuously, first set `Torque Enable` to `OFF` (left) and then choose `Wheel` (red circle). Clicking on `Goal Velocity` gives options for continuous rotation (right).

Step 2: Rotate continuously

Selecting `Goal Velocity` (**Figure 3-1 right**) one can choose to rotate the XL-320 servo horn clockwise or counter-clockwise. One can also type a numeric value (0 to 2047) and after hitting the `Apply` button, the XL-320 servo horn will rotate at the speed. Type in `0` and push `Apply` to stop the servo.

Exercise 2:

2-1 What is the maximum angular velocity in degrees/sec?

2-2 Set the angular velocity to 150. With a stopwatch, how many seconds does it take for the XL-320 servo horn to rotate once?

Congratulations! You can command XL-320 to desired angular positions and rotate continuously at desired angular velocities