

Smart Tool Application Tutorial

Revision History

[illegible]



Table of Contents

Preface	II
Chapter 1 Smart Tool Component Application Installation	1
1. 1 Types of Smart Tool Applications	1
1. 2 Smart Tool Assembly and Application.....	1
1. 2. 1 Hardware Instructions	1
1. 2. 2 Installation Example.....	2
Chapter 2 Configuration Methods and Electrical Connection Ports Introduction	5
2. 1 Introduction to Electrical Connection Ports	5
2. 2 Teaching Page Configuration.....	5
2. 2. 1 Smart Tool Communication Configuration.....	5
2. 2. 2 Smart Tool Button Function Configuration Description.....	6
2. 2. 3 Configuration of ABCDE Function Keys.....	6
Chapter 3 Smart Tool Application Examples.....	7
3. 1 Teaching Example of Movement Program	7
3. 2 Teaching Example of Basic Welding Program.....	10



Preface

Using the FR collaborative robot and Smart Tool components enables rapid programming and debugging for welding tasks. It effectively addresses the shortcomings of traditional manual welding. Manual welding often suffers from poor consistency and repeatability, low production efficiency, and poses health risks to workers. In contrast, with simple programming, the FR collaborative robot combined with Smart Tool components can edit welding programs for the robot, significantly replacing manual labor, reducing occupational hazards, and freeing up human resources. At the same time, it improves production efficiency and product quality, allowing for quick redeployment of production lines and achieving efficient, high-quality, and flexible robotic welding operations.

Chapter 1 Smart Tool Component Application Installation

1.1 Types of Smart Tool Applications

Smart Tool is primarily used in environments for welding programming. With Smart Tool, users can quickly configure linear motion commands, point-to-point motion commands, circular motion commands, and I/O input/output functions. It allows for fast programming directly at the end of the device. When used with the FR collaborative robot, it significantly reduces the learning curve and complexity of programming, enabling frontline workers to become actual operators and users of the robot.

1.2 Smart Tool Assembly and Application

1.2.1 Hardware Instructions

Smart Tool offers two modes of use, categorized as follows:

1. Used in combination with a force sensor: the Smart Tool handle and force sensor functionalities are integrated.

2. Used independently: the Smart Tool handle alone can be used for programming through the web-based teaching interface.

The image below shows the physical Smart Tool device



Figure 1.1 Smart Tool Physical Device

Button Function Descriptions:

- **Undo:** Reverts the last operation
- **Clear Program:** Clears the script program in the current file
- **A/B/C/D/E:** Configurable function buttons
- **Manual/Auto:** Switches robot mode
- **Start:** Executes the completed program
- **I/O:** Configures output channels for arc-start signals; can also be bound to other action commands

1.2.2 Installation Example

Smart Tool installation example:

1. First, remove the 4 screws on the outer shell, as shown in Figure 1.2, indicated by the arrows.

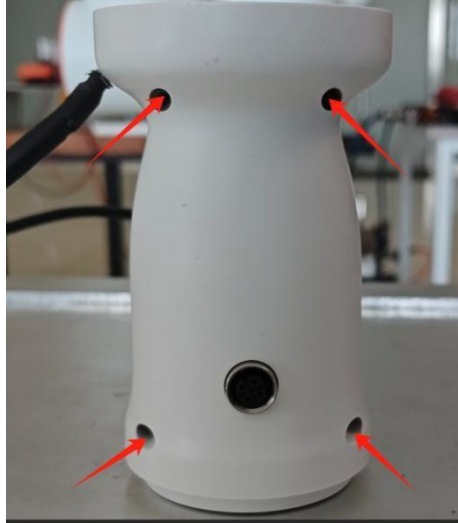


Figure 1.2 Smart Tool Screw Removal Diagram

2. After disassembly, as shown in Figure 1.3, the disassembled Smart Tool components include the front and back of the outer shell, an RS-485 communication cable, and a TCP end connector.

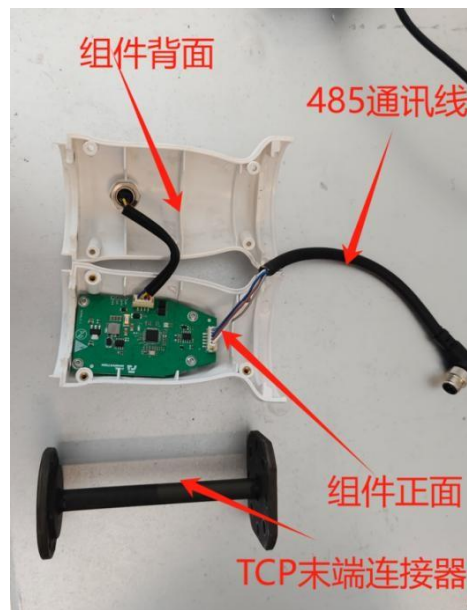


Figure 1.3 Smart Tool Disassembled View

3. Install the TCP end connector, as shown in Figure 1.4. The TCP end connector is mounted on the robot's end effector.



Figure 1.4 Robot End Effector

4, Firsts align the screw holes of the end connection device with the robot end effector. To be compatible with various robot ends, the Smart Tool's TCP connector has multiple mounting holes. The screw alignment diagram is shown in Figure 1.5. Once aligned, fasten with screws to secure it.



Figure 1.5 Screw Hole Alignment Between Robot End and TCP Connector



Figure 1.6 Installed Smart Tool Component

6. Install the RS-485 communication cable. After mounting is complete, connect the RS-485 cable for signal communication. When installing the RS-485 cable, align the groove on the robot's end interface with the protrusion on the RS-485 cable, as shown in Figures 1.7 and 1.8. The areas indicated by arrows must be aligned.



Figure 1.7 Robot End Interface



Figure 1.8 RS-485 Interface

Chapter 2 Configuration Method and Electrical Connection Port Introduction

2.1 Introduction to Electrical Connection Ports

RS-485 uses differential signal transmission technology and transmits data through two signal lines (A and B), offering strong anti-interference capability. This method effectively reduces the impact of electromagnetic interference and noise. Wiring must strictly follow the core functions during installation, as shown in Figure 2.1.

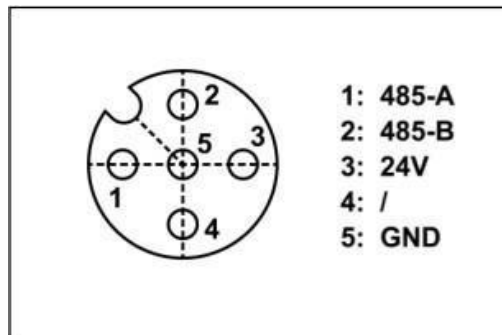


Figure 2.1 RS-485 Communication Cable Core

2.2 Teaching Page Configuration

2.2.1 Smart Tool Communication Configuration

This example uses a single handle. As shown in Figure 2.2, log into the web interface, select User Peripheral Configuration >> End Device Configuration >> and then choose the device type, manufacturer, and model in order. Click Configure. (If used with a force sensor, select FR as the manufacturer and use the Xinjingcheng protocol.)

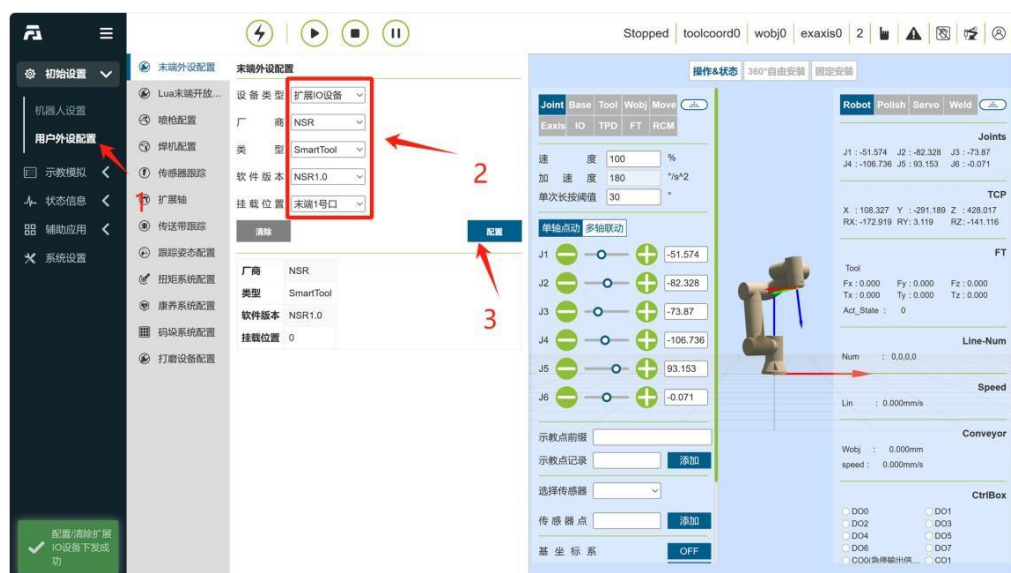


Figure 2.2 Smart Tool Communication Configuration Steps

2.2.1 Smart Tool Button Function Configuration Description

Click Auxiliary Applications >> Select Smart Tool >> then configure button functions and point speed settings. For I/O, configure CO2 (arc start) and choose to bind actions, as shown in Figure 2.3.

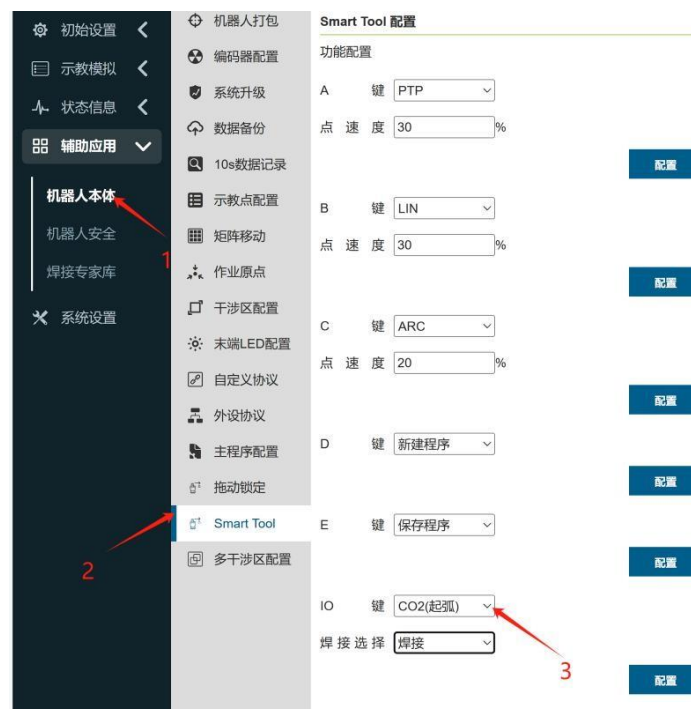


Figure 2.3 Welding Function Configuration

2.2.2 Configuration of ABCDE Function Keys

The Smart Tool component includes five customizable buttons, with functions shown in Figure 2.4. These functions allow the operator to quickly perform point teaching and welding process setup.



Figure 2.4 Smart Tool Custom Function Buttons

Chapter 3 Smart Tool Application Examples

3.1 Teaching Example for Movement Program

First, customize ABCDE buttons as PTP, LIN, ARC, New Program, and Save Program respectively, as shown in Figure 3.1. Then proceed to program teaching. During this process, the web interface must be in Teaching Simulation >> Program Teaching, otherwise programming is not possible.

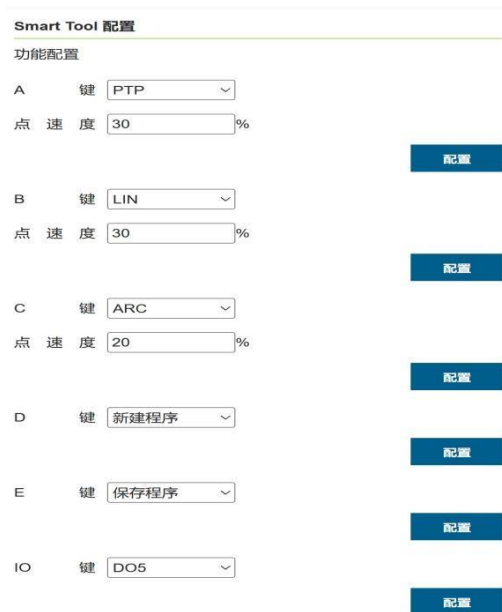


Figure 3.1 Button Customization

Press the D key to create a new program. As shown in Figure 3.2, "SmartToolxx.lua" appears in the lower left corner, indicating that the program was successfully created.

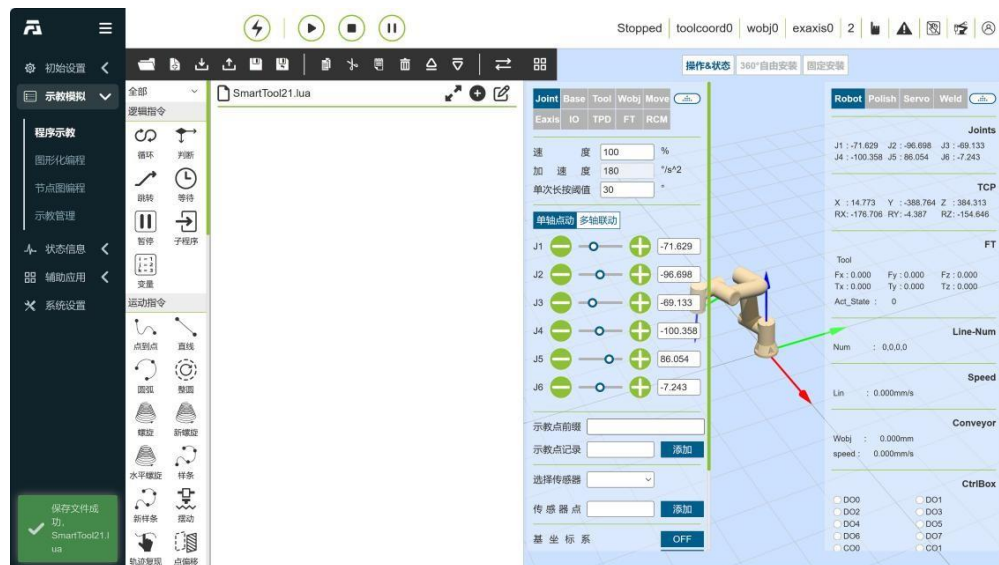


Figure 3.2 Creating a New Smart Tool Program

Next, press the A key to save the current position as a PTP destination point. As shown in Figure 3.3, a "command issued successfully" message appears in the lower left, indicating that the PTP instruction was created successfully

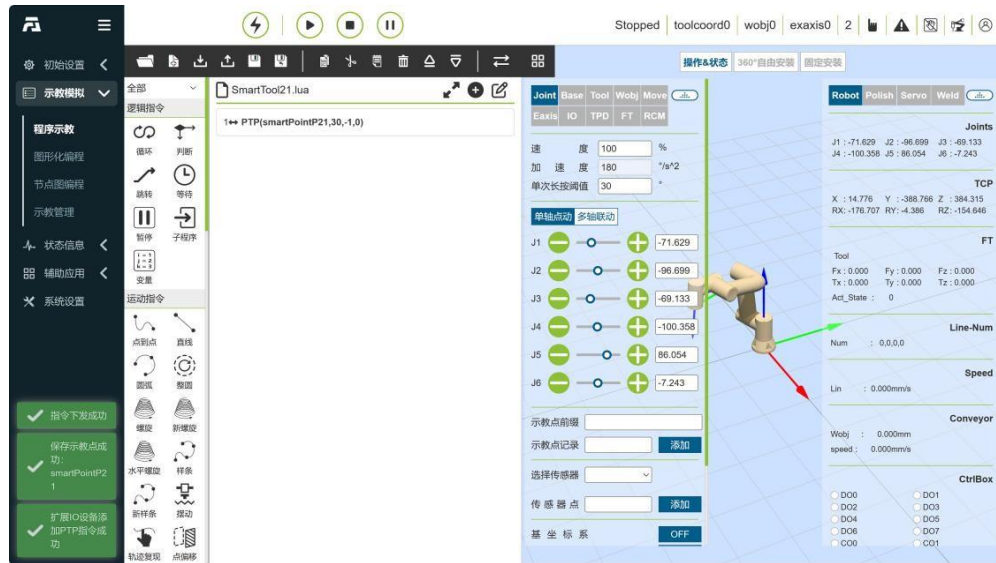


Figure 3.3 Creating a Smart Tool PTP Command

Move the robot to a new point and press the B key to save the current position as a LIN destination point. As shown in Figure 3.4, a "command issued successfully" message indicates successful creation of the LIN command.

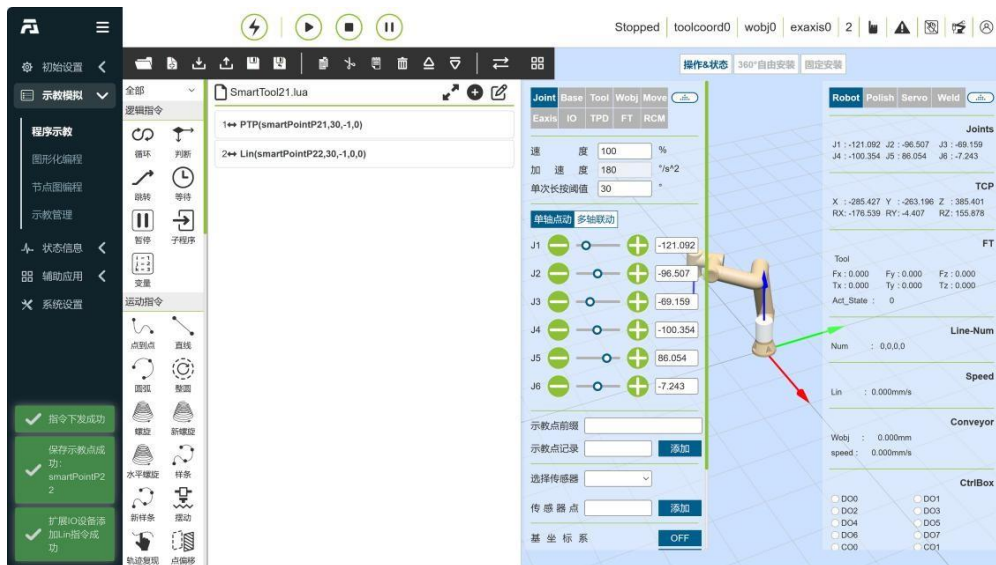


Figure 3.4 Creating a Smart Tool LIN Command

Move the robot to the middle point of the arc and press the C key to save it as the midpoint of an ARC. As shown in Figure 3.5, a success message appears. Then move the robot to the arc endpoint and press the ARC button again. As shown in Figure 3.6, another success message confirms creation of the ARC command.

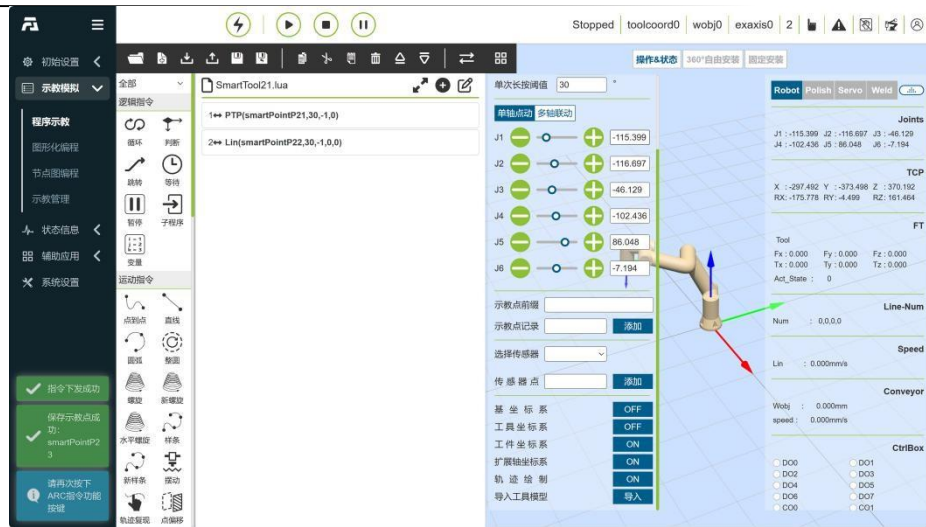


Figure 3.5 Creating First ARC Point

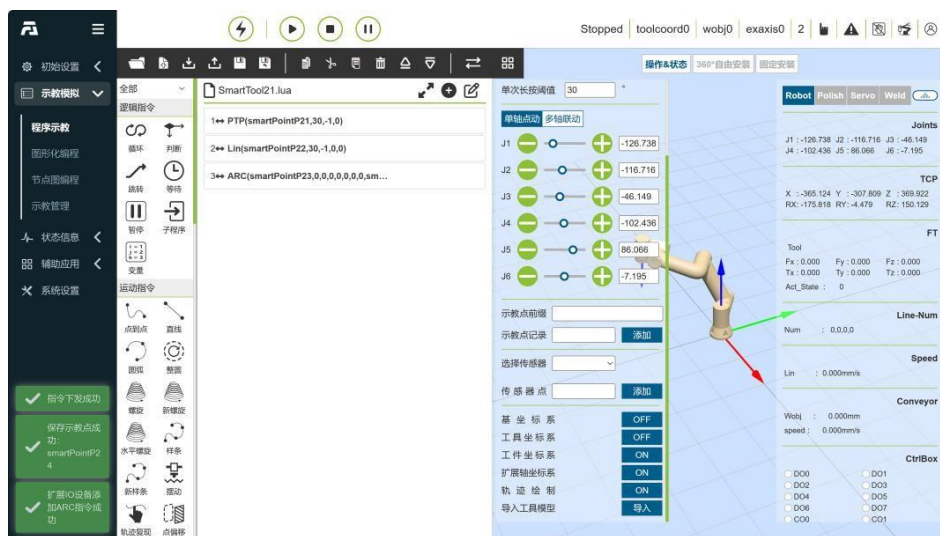


Figure 3.6 Creating Second ARC Point

Press the E key to save the program. As shown in Figure 3.7, a "file saved successfully" message confirms the program is completed.

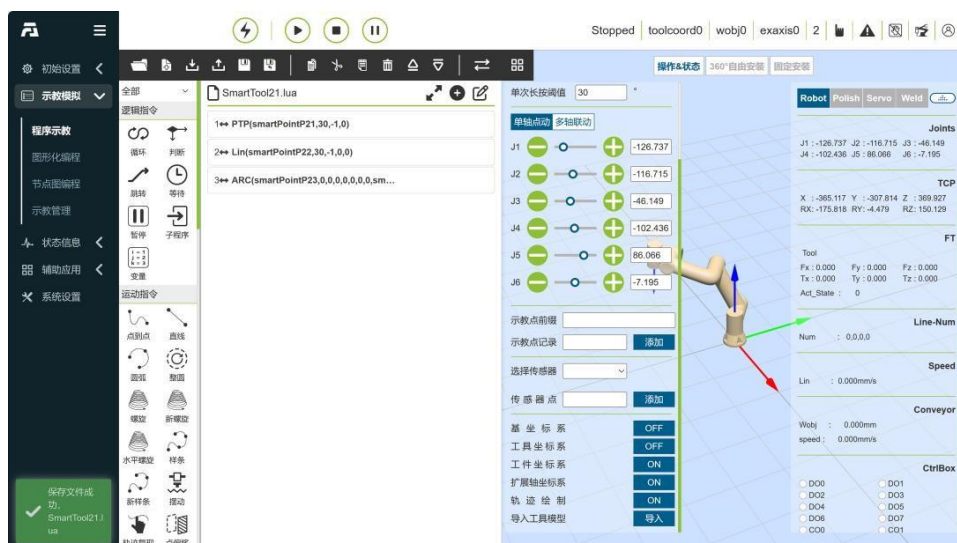


Figure 3.7 Saving the Program

Press the manual/auto switch button. When the indicator light at the robot's end changes from green to blue, as shown in Figure 3.8, it indicates a successful switch to auto mode. Press the Start button to run the program.



Figure 3.8 Robot End Indicator Light

3.2 Teaching Example for Basic Welding Program

In welding, I/O interface calls are required. As shown in Figure 3.9, define the I/O output as CO2 (arc start) to 辅助 LIN + welding instructions. Then proceed with program teaching. During this process, the web interface must be in Teaching Simulation >> Program Teaching, otherwise programming is not possible.

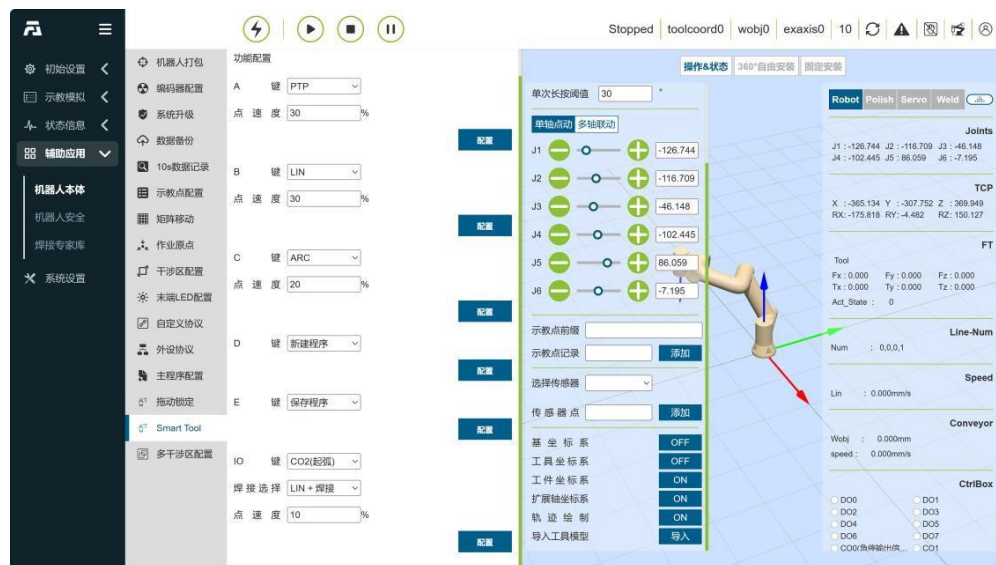


Figure 3.9 Smart Tool I/O Instruction Setup

First, press the Clear Program button to remove the previously edited movement instructions. The teaching interface will display "Extended I/O Device Program Cleared" as shown in Figure 3.10.

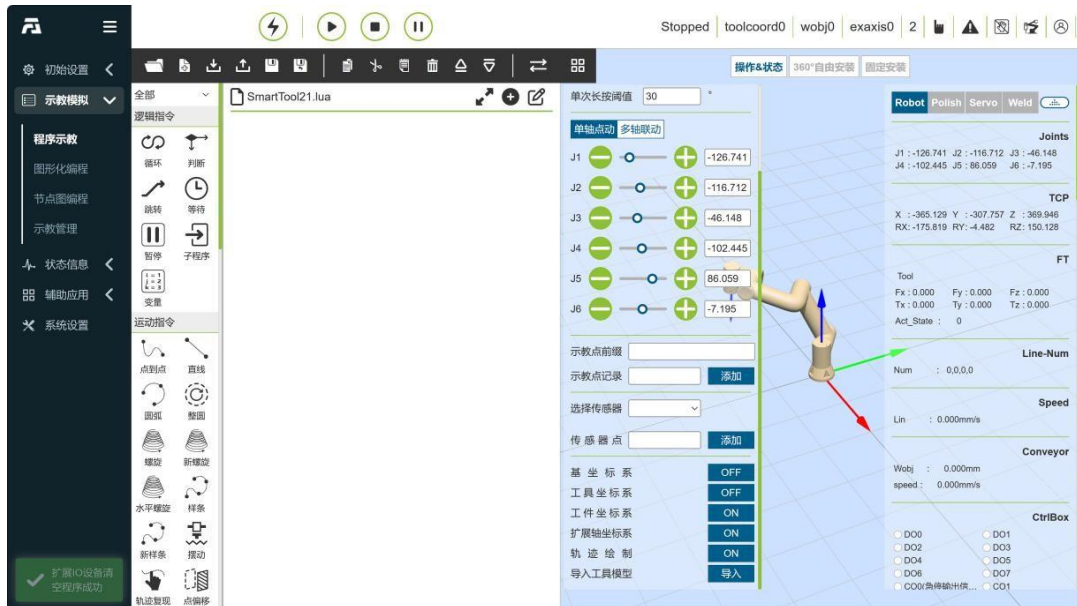


Figure 3.10 Clearing Program with Smart Tool

Press the I/O button to output the arc start command, which will also create a LIN movement instruction to move to the current position, as shown in Figure 3.11.

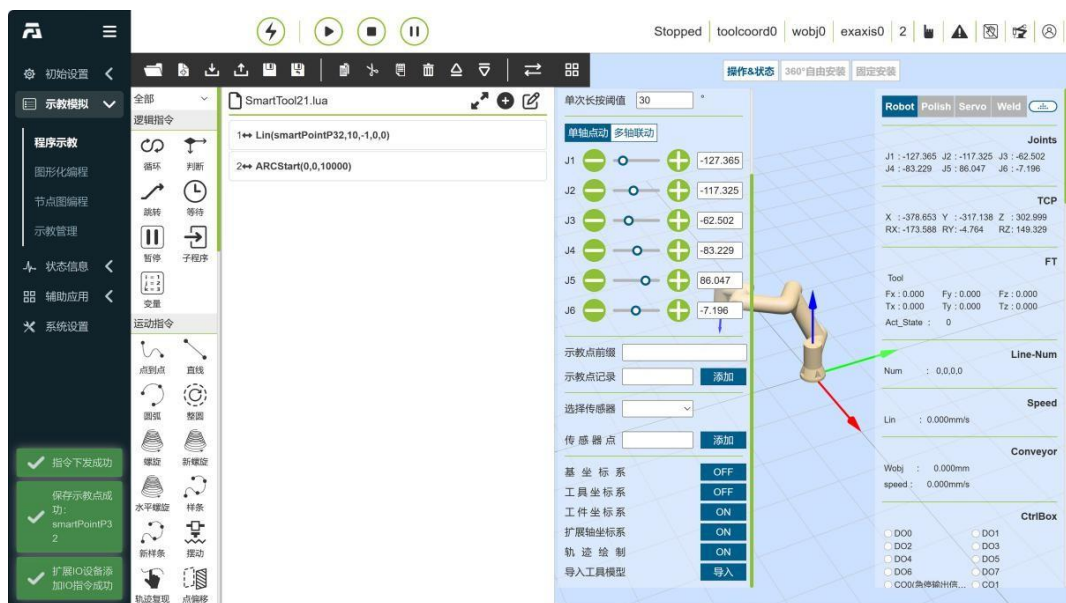


Figure 3.11 Outputting Arc Start Instruction

Move to the welding endpoint and press the I/O button again. This time, a LIN movement to the current point is created along with the arc stop instruction, as shown in Figure 3.12.

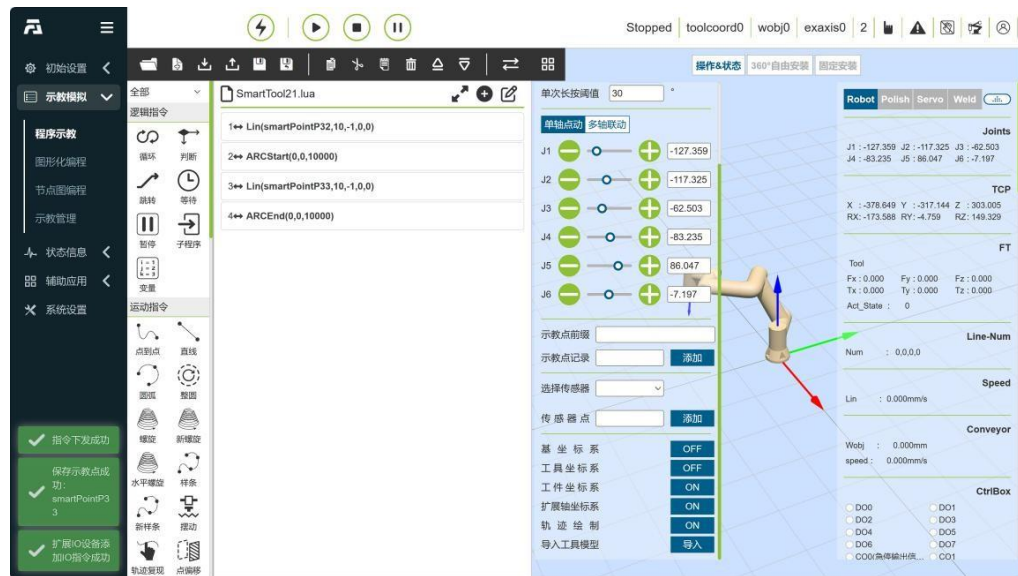


Figure 3.12 Outputting Arc Stop Instruction