Position PID

Position PID control compares the difference between the actual output and the expected output, and adjusts the control output according to the size of the error.

Position discrete PID formula

$$U_k = K_p * e(k) + K_i * \sum e(k) + K_d[e(k) - e(k-1)]$$

- Uk: output
- e(k): current deviation
- e(k-1): last deviation
- Kp: proportional term parameter
- Ki: integral term parameter
- Kd: differential term parameter

$$\sum e(k) : the cumulative sum of e(k) deviation$$

Difference between position/incremental PID

> **Position PID**

Position PID calculates the current deviation value (difference between target value and actual value), integral value (sum of past errors) and differential value (error change rate), and then adds these three parts to obtain the PID output.

> **Incremental PID**

Incremental PID obtains the PID output increment by calculating the change in the difference between the current error and the previous error.

```
Positional PID requires accumulation of integral terms, which is suitable for
situations where the system has high requirements for steady-state error.

Incremental PID does not require accumulation of integral terms, which is
suitable for situations where the system has high requirements for response
speed.
```

Code implementation

Positional PID is position closed-loop control. Position closed-loop control is to measure the position information of the motor based on the pulse accumulation of the encoder, and compare it with the target value to obtain a deviation. Then we control the deviation proportionally, integrally, and differentially to make the deviation approach 0.

```
int Position_PID (int position,int target)
{
static float error,Pwm,Integral_error,Last_error;
error=target-position; // Calculate deviation
Integral_error+=error; // Calculate the integral of the deviation
if(Integral_error>1000)Integral_error=1000;
if(Integral_error<-1000)Integral_error=-1000;

Pwm=Position_KP*error+Position_KI*Integral_error+Position_KD*(error-Last_error);
// Position PID controller

Last_error=error; // Save the last deviation
return Pwm; // Incremental output
}
```

Software code

Since the relevant peripheral driver tutorial has been introduced before, it will not be introduced here!

```
Source code path of product supporting materials: Attachment → Source code
summary → 3.PID_Course → 04.Position_PID
```

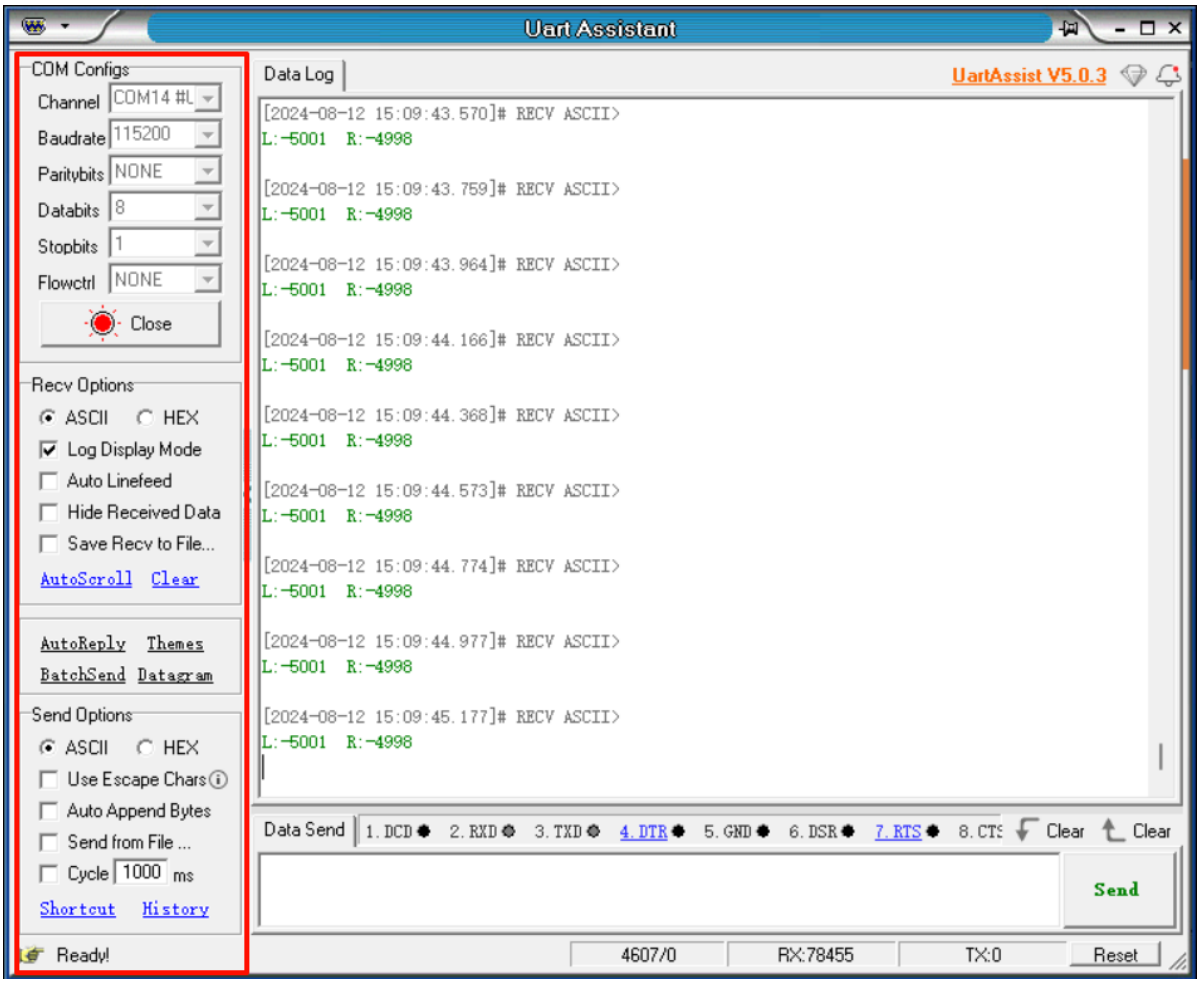
Experimental phenomenon

The Position_PID.hex file generated by the project compilation is located in the OBJ folder of the Position_PID project. Find the Position_PID.hex file corresponding to the project and use the FlyMcu software to download the program.

After the program is successfully downloaded: the motor will rotate to the vicinity of the preset encoder count value, the serial port will print the button status and the motor encoder value (corresponding to the distance the motor rotates), and the button can switch the LED status and control the motor to run to the set pulse position and stop.

Note: Since each motor is different, the value printed by the serial port may be a little different from the value set by the program; we can modify the Kp, Ki, and Kd parameters in the program to make the encoding value as close to the value set by the program as possible.

```
When using the serial port debugging assistant, you need to pay attention to the
serial port settings. If the settings are wrong, the phenomenon may be
inconsistent.
```


Uart Assistant
COM Configs
Channel COM14 #L
Baudrate 115200
Paritybits NONE
Databits 8
Stopbits 1
Flowctrl NONE
Close
Recv Options
ASCII HEX
Log Display Mode
Auto Linefeed
Hide Received Data
Save Recv to File...
AutoScroll Clear
AutoReply Themes
BatchSend Datagram
Send Options
ASCII HEX
Use Escape Chars
Auto Append Bytes
Send from File ...
Cycle 1000 ms
Shortcut History
Ready!
Data Log
UartAssist V5.0.3
[2024-08-12 15:09:43.570]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:43.759]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:43.964]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:44.166]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:44.368]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:44.573]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:44.774]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:44.977]# RECV ASCII>
L:-5001 R:-4998
[2024-08-12 15:09:45.177]# RECV ASCII>
L:-5001 R:-4998
Data Send
1. DCD 2. RXD 3. TXD 4. DTR 5. GND 6. DSR 7. RTS 8. CTS
Clear Clear
Send
4607/0 RX:78455 TX:0 Reset