SOP for Online Ultrasonic Sensor Debugging

Part 1: Online Debugging of Energy and P Value of Ultrasonic KS236 Using Scripts

I. Procedure for Online Adjustment of KS236 Ultrasonic Energy

Enter the following commands (using Halo104 and modifying probe #1's energy as an example):

a). **docker stop ultrasonic_sensors**

b). **python3 ./ks236_energy_set.py ** #Configuring the KS236 ultrasonic energy:

**--probe 1 ** # Specify probe #1

**--range 2.5 ** # Specify max detection range: 2.5m

**--energy 1 ** # Specify energy threshold: 1

**--time 2 ** # Specify sampling time: 2

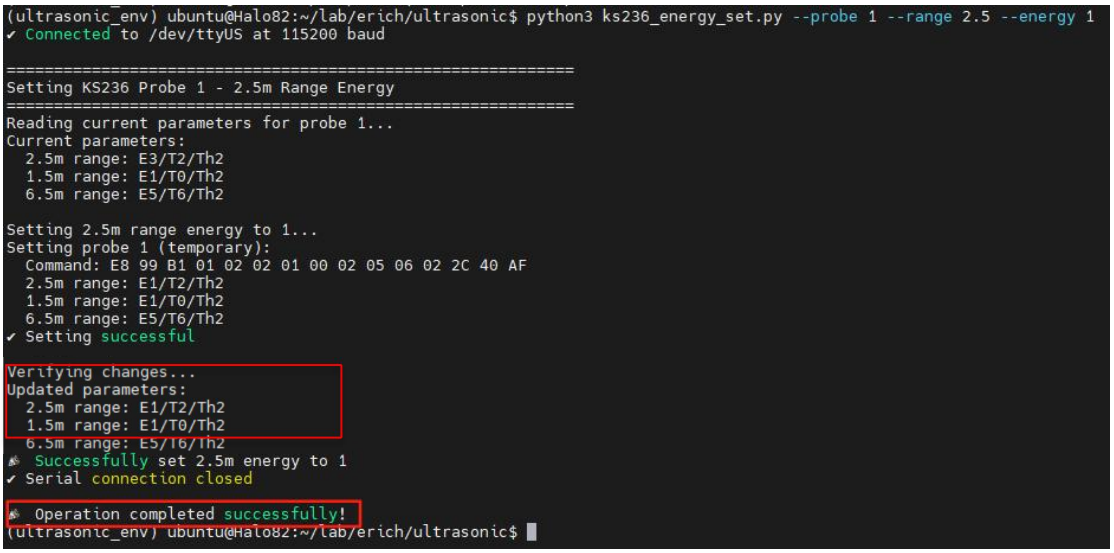
**--threshold 2 ** # Specify alarm trigger threshold: 2

**--device /dev/ttyUS ** # Specify device path, default: /dev/ttyUS

**--baudrate 115200 ** # Specify baud rate, default: 115200

--permanent # Permanent mode, saves to EEPROM

Configuration is successful when the following prompt appears:



Successfully set energy for probe 1

c). **docker start ultrasonic_sensors**

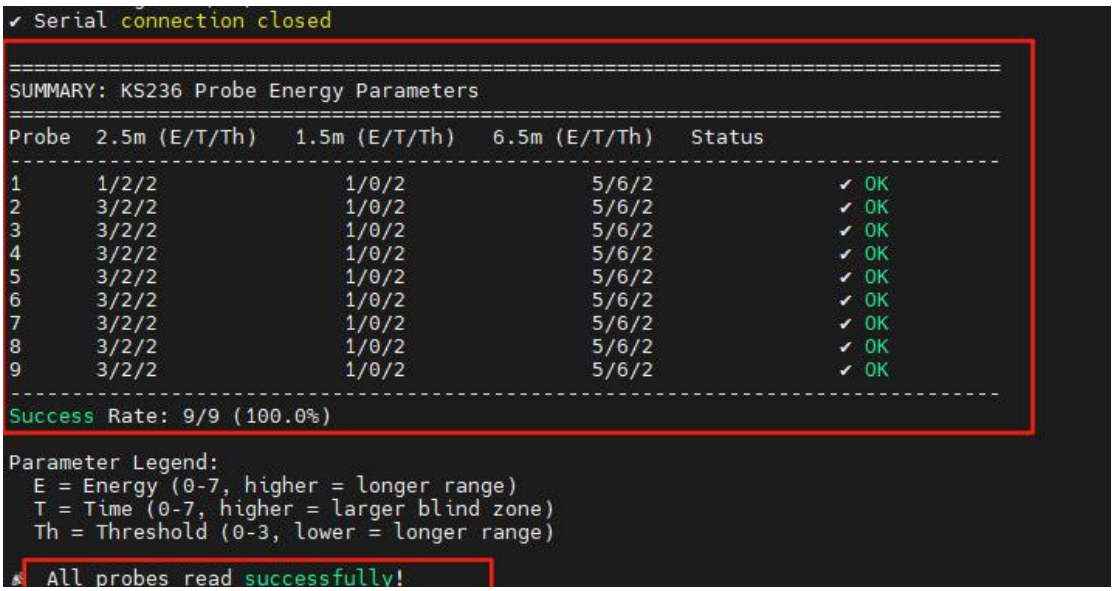
d). **deactivate**

P.S.:Using the -h or --help option will show you all available options and some examples for the script.

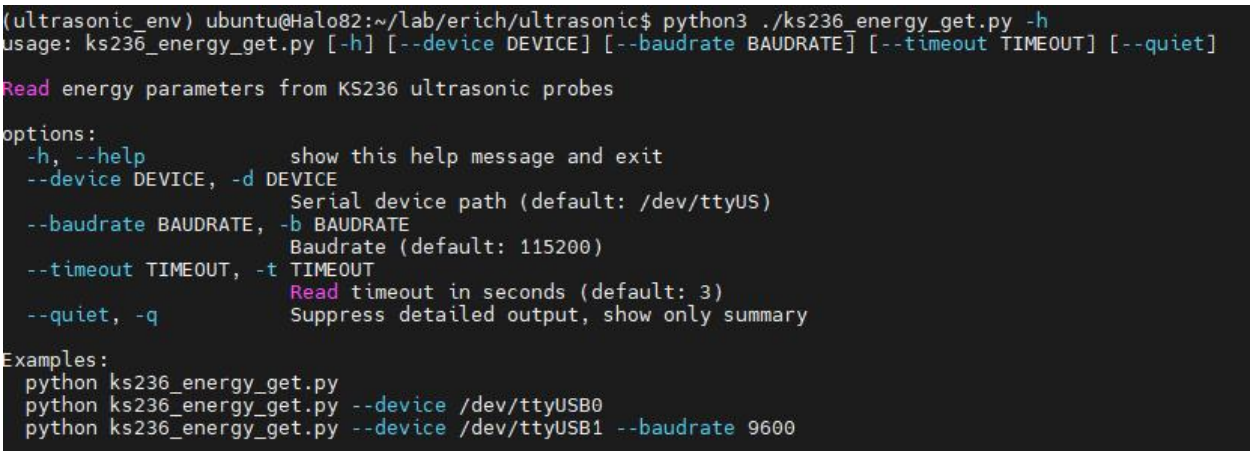
Using -h or --help can show all available options

II. Procedure for Online Viewing of KS236 Ultrasonic Energy Configuration

Enter the following commands (using Halo104 and viewing probe #1's energy as an example):
a). **docker stop ultrasonic_sensors**
b). **python3 ks236_energy_get.py** #View the KS236 ultrasonic energy configuration
Detection is successful when the following table appears:



c). **docker start ultrasonic_sensors** # Run steps j and k if no further steps are needed, otherwise skip.
d). **deactivate**
P.S.:Using the -h or --help option will show you all available options and some examples for the script.



Using -h or --help can show all available options

III. Procedure for Online Adjustment of KS236 Ultrasonic P-Value (Segmented FOV)

Enter the following commands (using Halo104 and modifying probe #1's P-values as an example):

a). **docker stop ultrasonic_sensors**

b). **python3 ./ks236_p_set.py ** #Configure the KS236 ultrasonic segmented P-values (FOV)

**--probe 1 ** # Specify probe #1

**--p1 10 ** # Specify p1 value: 10, FOV range: 22.5cm~42.5cm

**--p2 10 ** # Specify p2 value: 10, FOV range: 42.5cm~59.5cm

**--p3 12 ** # Specify p3 value: 12, FOV range: 59.5cm~76.5cm

**--p4 31 ** # Specify p4 value: 31, FOV range: 76.5cm~110cm

**--p5 31 ** # Specify p5 value: 31, FOV range: 110cm~144cm

**--p6 31 ** # Specify p6 value: 31, FOV range: 144cm~178cm

**--p7 31 ** # Specify p7 value: 31, FOV range: 178cm~212cm

**--p8 31 ** # Specify p8 value: 31, FOV range: 212cm~246cm

**--p9 31 ** # Specify p9 value: 31, FOV range: 246cm~280cm

**--p10 31 ** # Specify p10 value: 31, FOV range: 280cm~348cm

**--p11 31 ** # Specify p11 value: 31, FOV range: 348cm~416cm

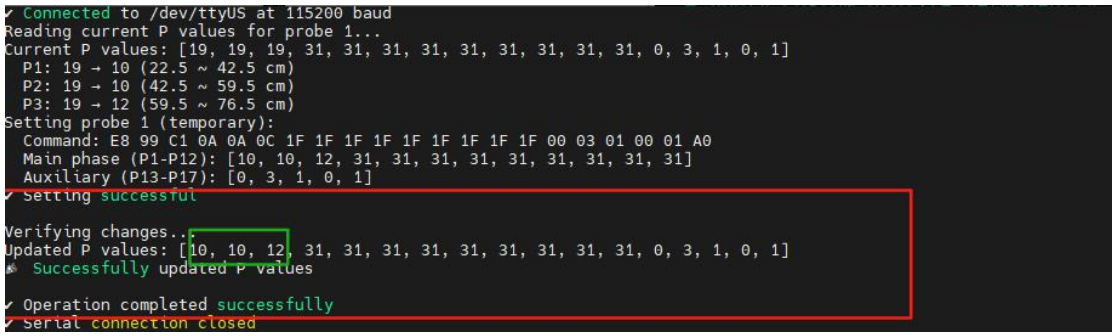
**--p12 31 ** # Specify p12 value: 31, FOV range: 416cm to max range

**--device /dev/ttyUS ** # Specify device path, default: /dev/ttyUS

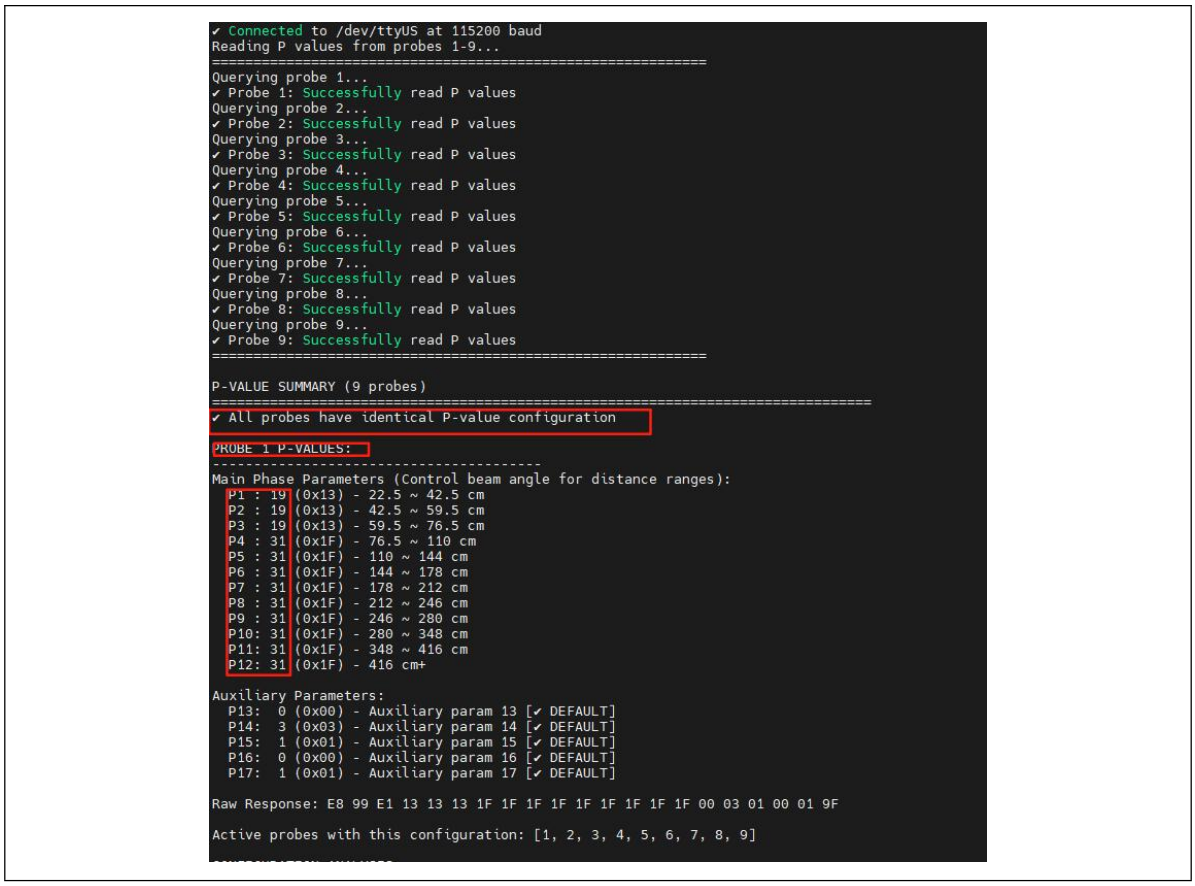
**--baudrate 115200 ** # Specify baud rate, default: 115200

--permanent # Apply changes permanently,default:temporary

Configuration is successful when the following prompt appears:



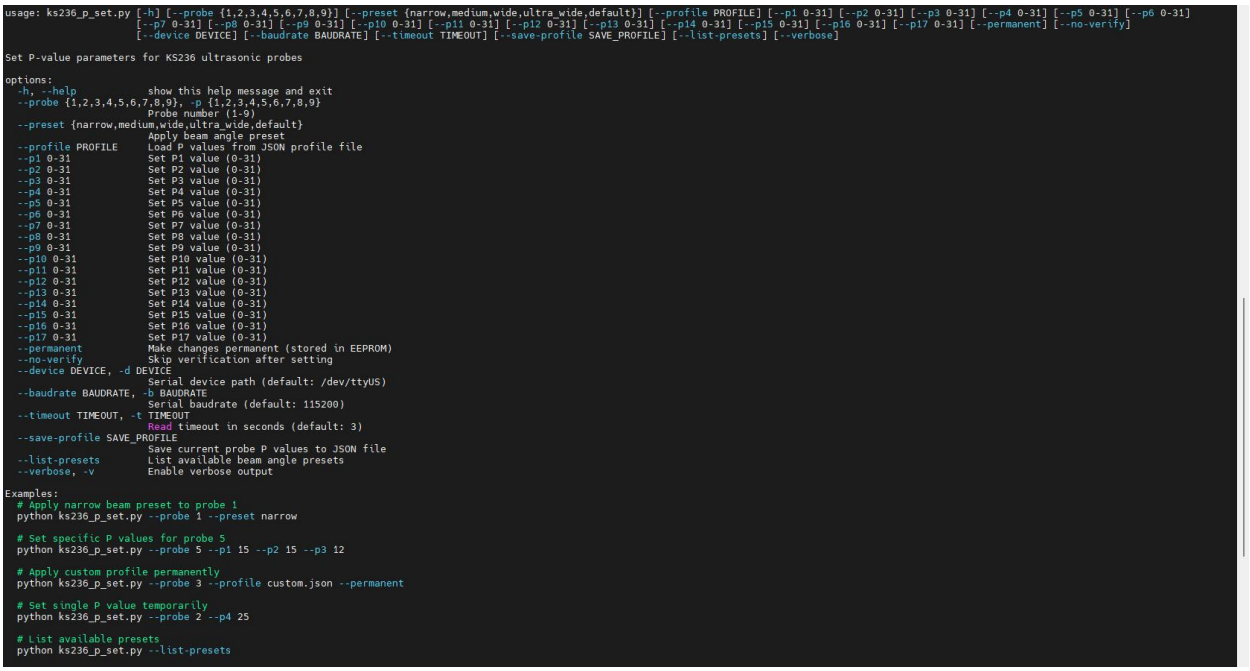
Note: If all probes are configured with the exact same P-values, the script will only display the configuration for probe #1.



c). **docker start ultrasonic_sensors**
d). **deactivate**
P.S.: For step b, to quickly reset to the **default configuration**, run:

```
python3 ./ks236_p_set.py \
        --probe 1 \
        --preset default \ #set p1=p2=p3=19,p4~p12=31 for probe 1 to probe 9
        --permanent
```

P.S.:Using the -h or --help option will show you all available options and some examples for the script.



```
usage: ks236_p_set.py [-h] [--probe {1,2,3,4,5,6,7,8,9}] [--preset {narrow,medium,wide,ultra_wide,default}] [--profile PROFILE] [--p1 0-31] [--p2 0-31] [--p3 0-31] [--p4 0-31] [--p5 0-31] [--p6 0-31]
                      [--p7 0-31] [--p8 0-31] [--p9 0-31] [--p10 0-31] [--p11 0-31] [--p12 0-31] [--p13 0-31] [--p14 0-31] [--p15 0-31] [--p16 0-31] [--p17 0-31] [--permanent] [--no-verify]
                      [--device DEVICE] [--baudrate BAUDRATE] [--timeout TIMEOUT] [--save-profile SAVE_PROFILE] [--list-presets] [--verbose]

Set P-value parameters for KS236 ultrasonic probes

options:
  -h, --help            show this help message and exit
  --probe {1,2,3,4,5,6,7,8,9}, -p {1,2,3,4,5,6,7,8,9}
                        Probe number (1-9)
  --preset {narrow,medium,wide,ultra_wide,default}
                        Apply beam angle preset
  --profile PROFILE     Load P values from JSON profile file
  --p1 0-31             Set P1 value (0-31)
  --p2 0-31             Set P2 value (0-31)
  --p3 0-31             Set P3 value (0-31)
  --p4 0-31             Set P4 value (0-31)
  --p5 0-31             Set P5 value (0-31)
  --p6 0-31             Set P6 value (0-31)
  --p7 0-31             Set P7 value (0-31)
  --p8 0-31             Set P8 value (0-31)
  --p9 0-31             Set P9 value (0-31)
  --p10 0-31            Set P10 value (0-31)
  --p11 0-31            Set P11 value (0-31)
  --p12 0-31            Set P12 value (0-31)
  --p13 0-31            Set P13 value (0-31)
  --p14 0-31            Set P14 value (0-31)
  --p15 0-31            Set P15 value (0-31)
  --p16 0-31            Set P16 value (0-31)
  --p17 0-31            Set P17 value (0-31)
  --permanent           Make changes permanent (stored in EEPROM)
  --no-verify           Skip verification after setting
  --device DEVICE, -d DEVICE
                        Serial device path (default: /dev/ttyUS)
  --baudrate BAUDRATE, -b BAUDRATE
                        Serial baudrate (default: 115200)
  --timeout TIMEOUT, -t TIMEOUT
                        Read timeout in seconds (default: 3)
  --save-profile SAVE_PROFILE
                        Save current probe P values to JSON file
  --list-presets        List available beam angle presets
  --verbose, -v         Enable verbose output

Examples:
  # Apply narrow beam preset to probe 1
  python ks236_p_set.py --probe 1 --preset narrow

  # Set specific P values for probe 5
  python ks236_p_set.py --probe 5 --p1 15 --p2 15 --p3 12

  # Apply custom profile permanently
  python ks236_p_set.py --probe 3 --profile custom.json --permanent

  # Set single P value temporarily
  python ks236_p_set.py --probe 2 --p4 25

  # List available presets
  python ks236_p_set.py --list-presets
```

Using -h or --help can show all available options

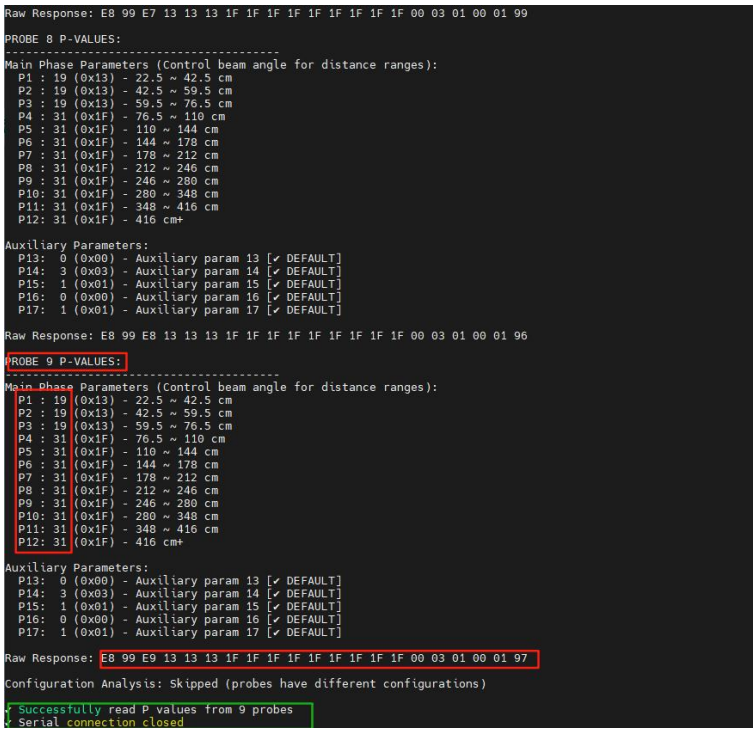
IV. Procedure for Online Viewing of KS236 Ultrasonic P-Value (Segmented FOV) Configuration

Enter the following commands (using Halo104 and viewing probe #1's P-value configuration as an example):

a). **docker stop ultrasonic_sensors**

b). **python3 ./ks236_p_get.py** #View the KS236 ultrasonic segmented P-value (FOV) configuration

The script will sequentially display the current P-values for probes 1 through 9. Scroll up to find the P-values for the desired probe. The script is finished when it displays "Successfully read P values" as shown in the image below.



c). **docker start ultrasonic_sensors**

d). **deactivate**

P.S.:Using the -h or --help option will show you all available options and some examples for the script.

```
(ultrasonic_env) ubuntu@Halo82:~/lab/erich/ultrasonic$ python3 ./ks236_p_get.py -h
usage: ks236_p_get.py [-h] [--device DEVICE] [--baudrate BAUDRATE] [--timeout TIMEOUT] [--verbose]

Read P-value parameters from KS236 ultrasonic probes

options:
  -h, --help            show this help message and exit
  --device DEVICE, -d DEVICE
                        Serial device path (default: /dev/ttyUS)
  --baudrate BAUDRATE, -b BAUDRATE
                        Serial baudrate (default: 115200)
  --timeout TIMEOUT, -t TIMEOUT
                        Read timeout in seconds (default: 3)
  --verbose, -v         Enable verbose output

Examples:
  python ks236_p_get.py                  # Read from default device
  python ks236_p_get.py --device /dev/ttyUSB0  # Use specific device
  python ks236_p_get.py --timeout 5      # Increase timeout
```

Using -h or --help can show all available options

Part 2: Procedures and Methods for Online Debugging of Ultrasonic KS236

Important Notes:

During testing, ensure that ***there are no other Halos or any devices using ultrasonic waves within 5 meters around the Halo!***
Ensure that the test space is at least 5m * 5m; otherwise, it is extremely prone to echo interference and intensified illusions.
Ensure that the tire pressure is within [15, 20] psi during testing.

Tips: The obstacles mentioned in the following text refer to those within the detection range of the probes (for US2~4, it should be in [0.2, 0.68]; for US1, 5~9, it should be in [0.2, 0.3]).

Under the above premises, when there is a serious ***illusion*** in the direction of a certain probe (that is, there are noise points even though there is no obstacle), please troubleshoot and debug according to the following steps:

Step 1. Open 2 new Smart+ windows in the browser, select the corresponding robot, and open the Pilot and Topic Monitor pages respectively. On the Pilot page, open Pilot Menu -> Map -> Map Streaming -> /move_base/global_costmap/local_costmap; in the search box on the Topic Monitor page, enter /ultrasonic_list. /ultrasonic_list will list the distance readings (value) of obstacles detected by each probe (key) in real-time. Find the problematic probe and compare the value of the probe before and after the illusion occurs. If any of the following four situations occur, troubleshoot in the order of wiping the probe surface with flexible fabric to remove possible grease and water stains, etc. -> reinstalling the probe -> replacing the probe and re-detecting:

Phenomenon A: When there is no obstacle, the value always reads an abnormal value (that is, the value is within the detection range of the probe).

Phenomenon B: When there is no obstacle, the value is [0.2, 0.8); when there is an obstacle, the value is [0.8, 2.55].

Phenomenon C: Regardless of the presence of obstacles, the value is always stable in [0.2, 0.8).

Phenomenon D: The value frequently jumps between 0.2 and [1, 2.55].

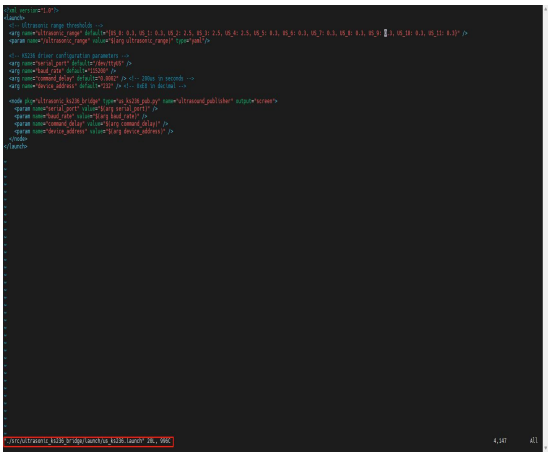
If the problem is solved, skip the subsequent steps; otherwise, proceed to Step 2.

Step 2. Connect to the Halo's control terminal via Smart+ Terminal (or connect the PC to LP's AP, right-click the Windows icon to open the terminal, and enter **ssh ubuntu@10.7.5.72**) and perform the following steps:

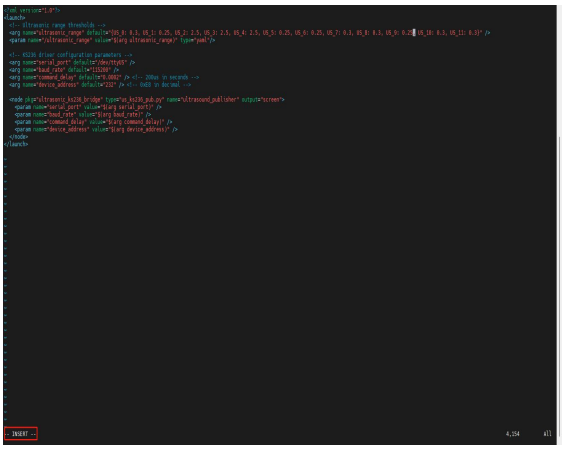
a. Enter **docker exec -it ultrasonic_sensors bash**

b. Enter **vim ./src/ultrasonic_ks236_bridge/launch/us_ks236.launch**

c. After entering the vim editor, press **i** to *enter edit mode.*



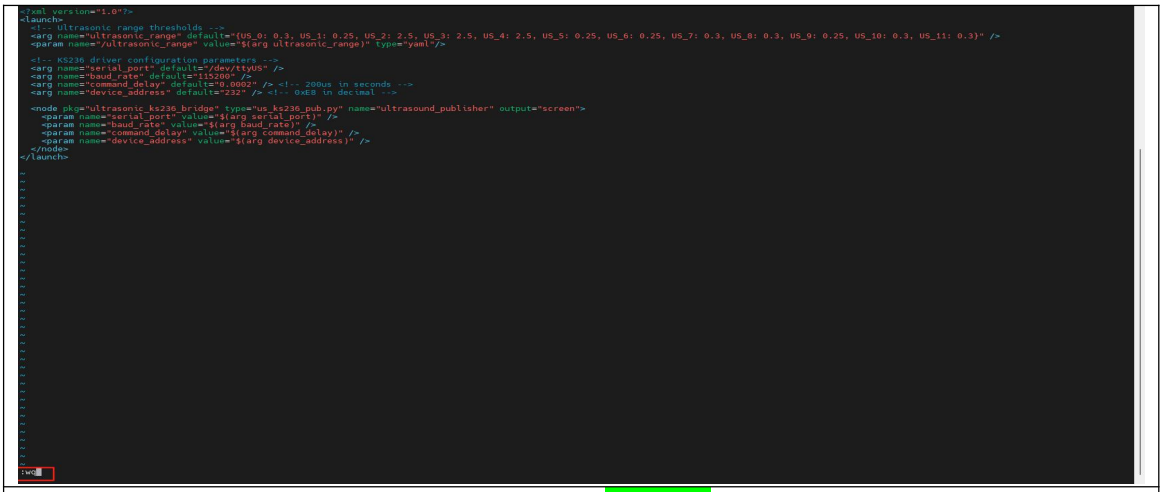
When entering vim, it is in normal command mode by default.



Press **i** to enter *edit mode*, and pay attention to "insert" in the lower left corner; to exit from edit mode to normal command mode, press **ESC**.

d. Find the problematic probe (US_1~9 correspond to US1~9), and modify the value behind it(It's recommended that each adjustment be made in increments of ±0.05, while ensuring the value staying within the range [0.0, 0.3]). ***This value represents the limit value at which the detection distance of each probe is fed back to the NAV PC and judged as an obstacle noise by the NAV PC (that is, it will not be judged as an obstacle by the NAV PC after exceeding this value).***

e. Press **ESC** to *exit edit mode*, and enter **:wq** to save and exit.



In normal command mode, press any one of **:, /, or ?** to enter command line mode. In this mode, enter **:wq** to save and exit.

f. Enter **exit**.

g. Enter **docker restart ultrasonic_sensors**

h. Retest. If the problem still cannot be solved, proceed to Step 3.

Step 3. Refer to the "Operating Steps for Online Adjustment of Ultrasonic KS236 Energy" in Part 1, **change the energy (2.5m range) of the corresponding problematic probe to 2 or 1 respectively** (that is, --energy takes 2 and 1 respectively) and retest (for 2.5m range, the default value of --energy is 3, the default value of --time is 2, and the default value of --threshold is 2). If it cannot be solved, proceed to Step 4.

Step 4. Refer to the "Operating Steps for Online Adjustment of P Value (Segmented FOV) of Ultrasonic KS236" in Part 1, and adjust the P value of the corresponding problematic probe.

Warning: The P values mentioned below are in decimal, but they will eventually be displayed in hexadecimal in the script.

For US1, US5~9: It is recommended that the value range of P1~P2 is [15, 24], the value range of P3 is [15, 23], and P4~P12 can be 31. For US2~4: It is recommended that the value range of P1~P3 is [15, 23], and P4~P12 can be 31. *Note: The smaller the P value, the larger the detection range of the probe, and the easier it is for ultrasonic waves to hit the ground; and vice versa. It is recommended to adjust the P value carefully.* Experiments show that: indoors, for US2~4, when P1=P2=10, P3=12, P4～P12=31; for US1, US5~9, when P1=P2=24, P3=23, P4～P12=31, the obstacle avoidance effect and navigation effect are the best. Outdoors or in poor road conditions, when all probes take P1=P2=P3=19, P4~P12=31, the obstacle avoidance effect and navigation effect are the best.