

Seismograph setup and maintenance manual ver. 1.1

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Any comments and questions are welcome

Seismometers set up

- Calm and rigid/stable place is better
- Need an electric power
- No wind and machine noises
- Easy to maintenance
- Check the phase direction of the signal: N-S, E-W, U-D
- → to move the pendulum and check the direction of the signal (the ground motion and the pendulum motion are exactly opposite!)

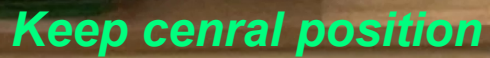
Adjustment of pendulums

- Vertical pendulum: only needs the weight balance
- Horizontal pendulum: keep the base horizontally: adjust 3 points of the bottom
- → One is a fixed pin, two are adjustable screws (see the next slide).
- 1) Whole inclination (about a few degree)
- 2) Transverse balance of two screws (indicate center of the pendulum direction)

Vertical pendulum: about 4 to 5 second



Horizontal pendulum: about 5 second



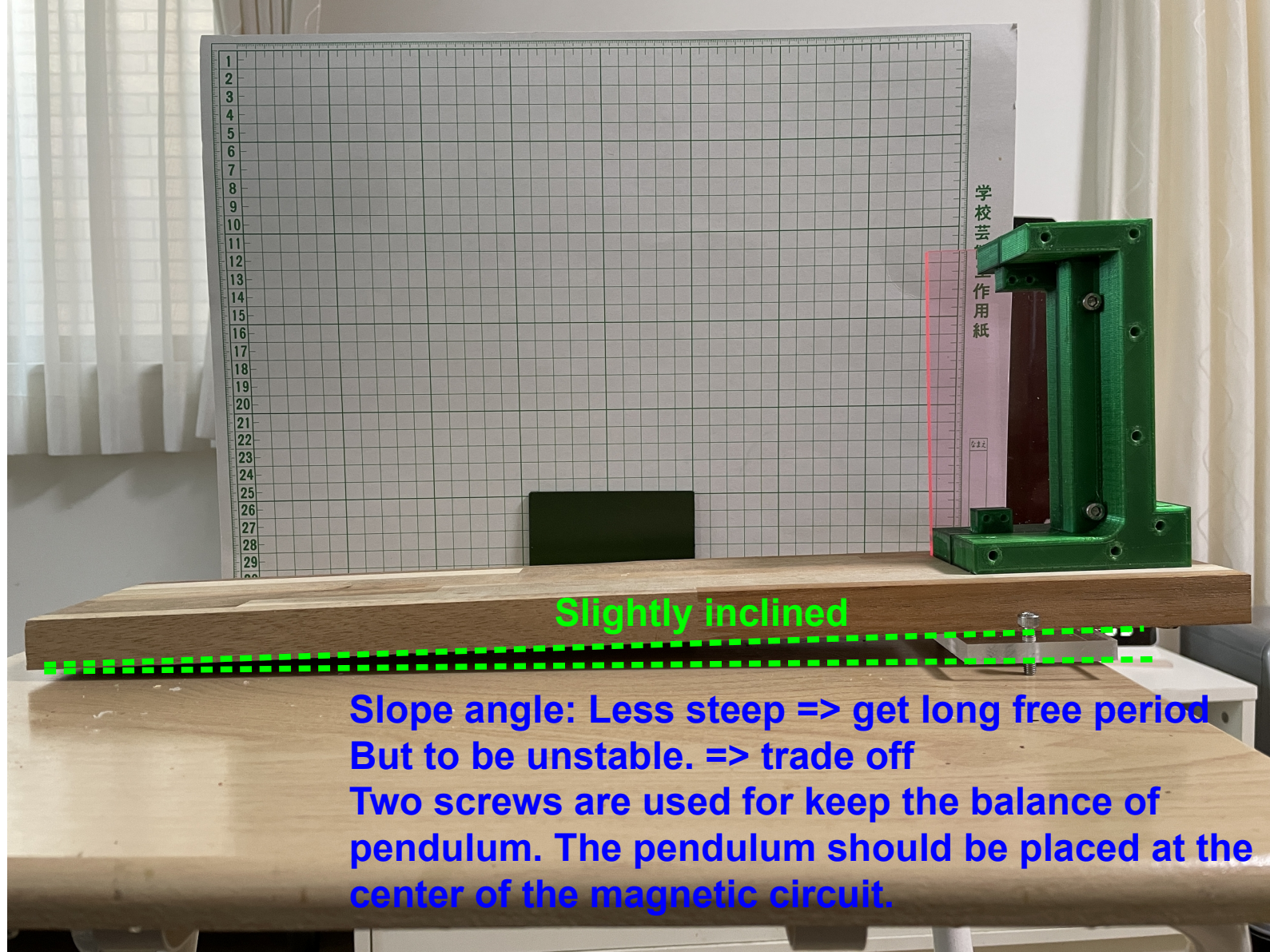
Adjustable screw



Fixed pin

Two screws

Bottom view: Two screws are used for keep the balance of pendulum. The pendulum should be placed at the center of the magnetic circuit. Also the slope angle is important => next slide.



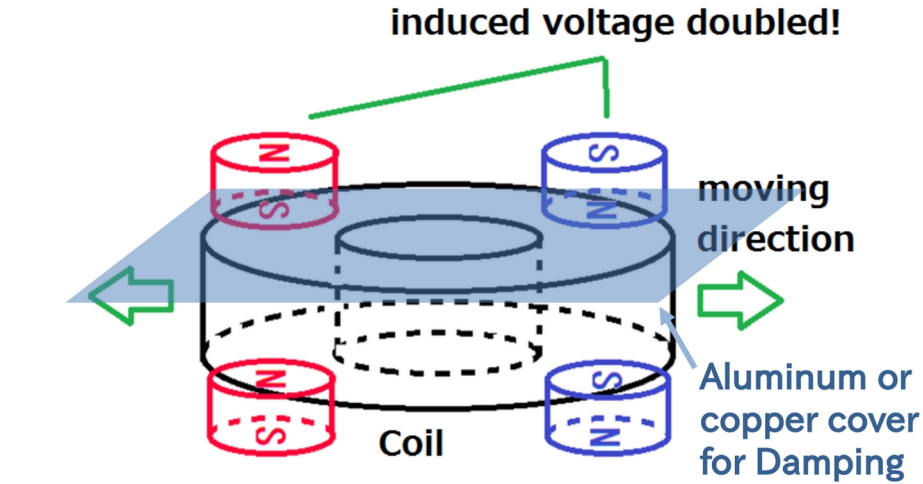
Slightly inclined

Slope angle: Less steep => get long free period
But to be unstable. => trade off
Two screws are used for keep the balance of
pendulum. The pendulum should be placed at the
center of the magnetic circuit.

Seismometers maintenance

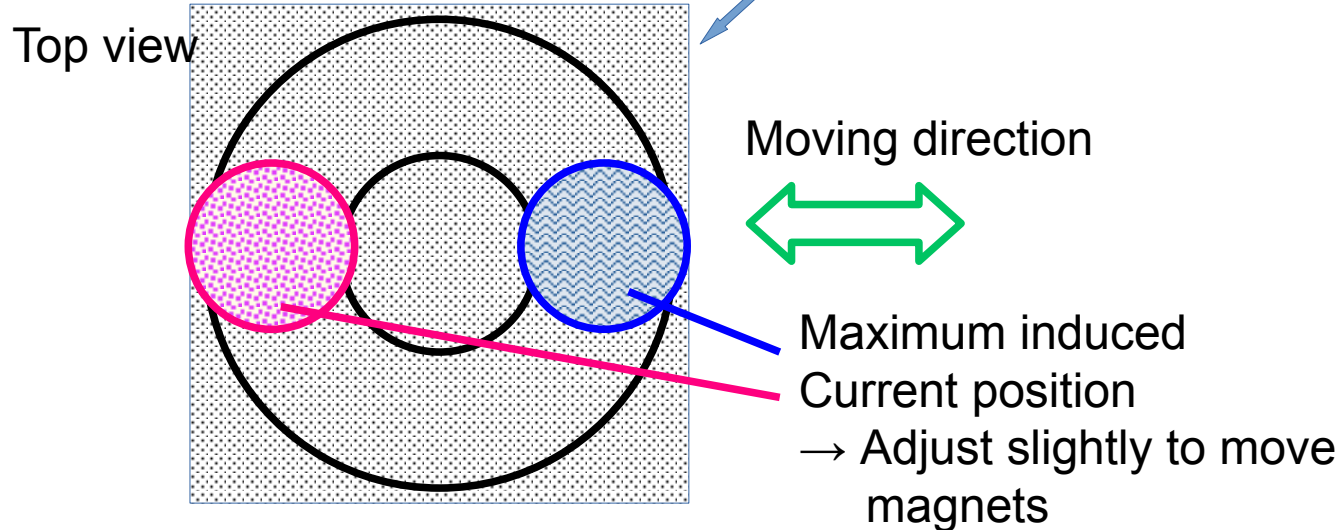
- Keep setting condition
 - Buckling of a pendulum due to gravity or thermal effect
- Touch down of vertical pendulum due to the spring aging
- Horizontal balance for horizontal pendulums adjusting two screws
- → Keep coil at center position
- Check the gaps between coil and magnets: sometimes they touched and wrong record is made
- Data back up to outside (USB memory and send via Google Drive)
- If the PC has some trouble → reboot the system

Structure of Electromagnetic sensor



Check the **magnet polarity**
And the **gaps** between coil
And magnets → see next slide

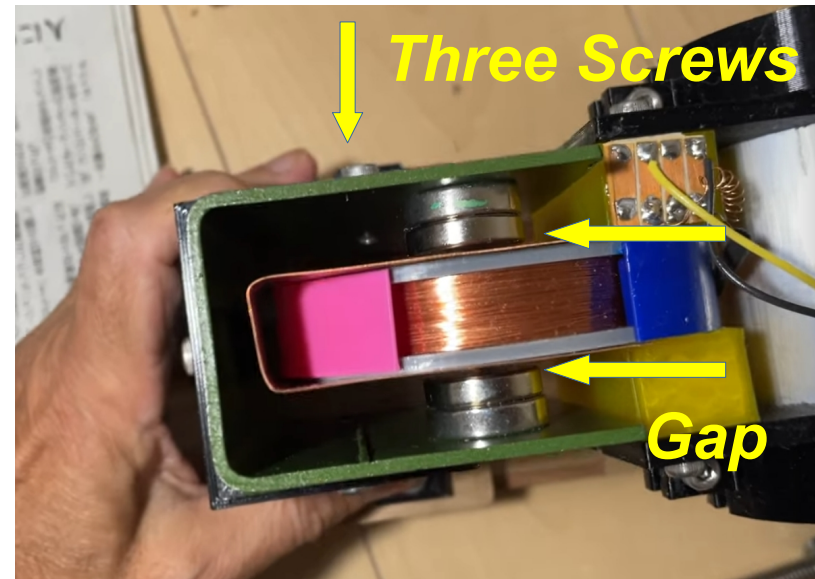
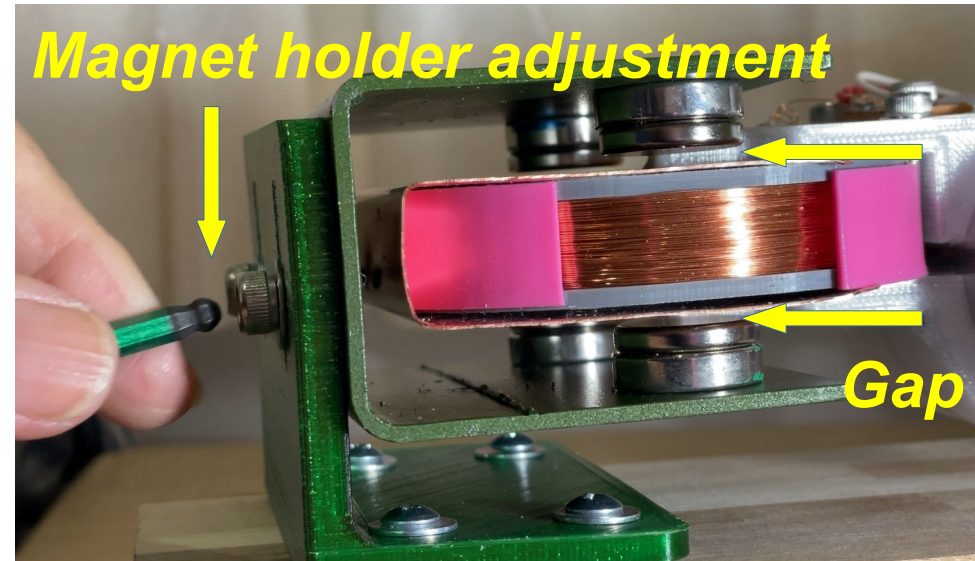
Caution: neodymium magnet
Has very strong force!



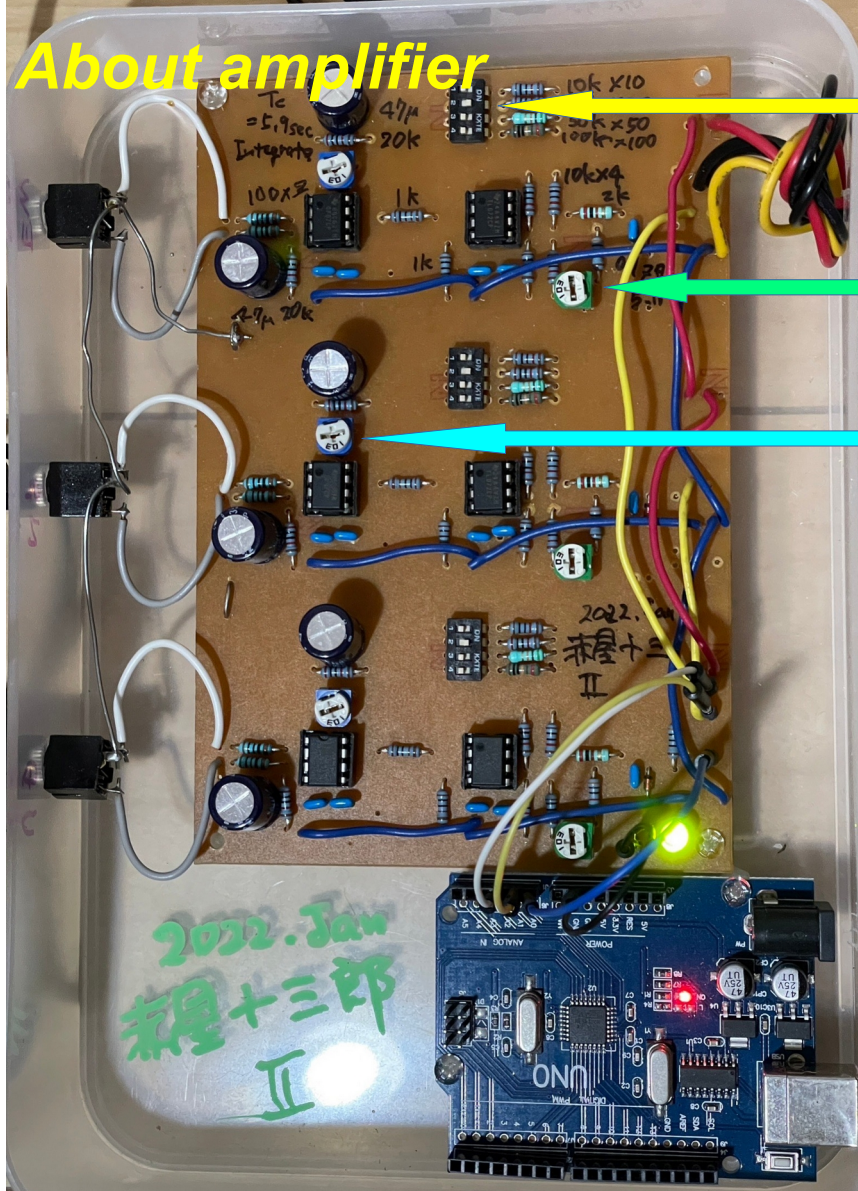
Sensor Tuning (see videos)

Gap adjustment by moving magnet holder
(important!)

- Horizontal
- <https://youtu.be/lqsGfkgxz8I>
- Vertical
- <https://www.youtube.com/shorts/ZfJ9rWQ7AOE>



About amplifier



Amplifier gain adjustment 2 or 3 is better
It depends on noise level at the observation site

Zero Level tuning VR

If you want to change the signal line position
On the PC display

OP07 amp offset tuning VR

Usually no need to adjustment

Usually no need to adjustment

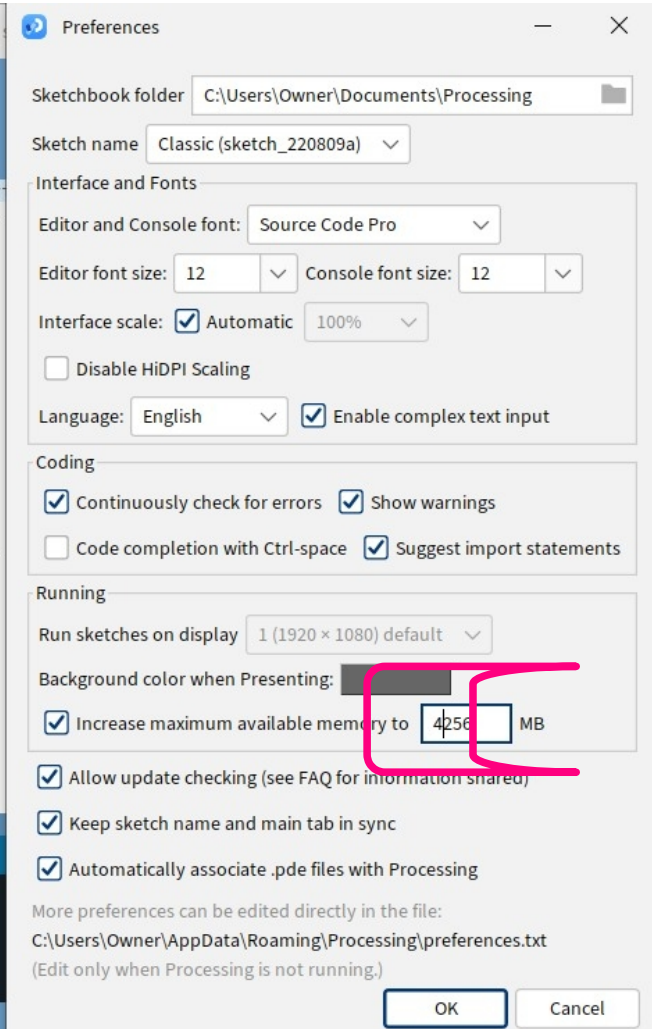
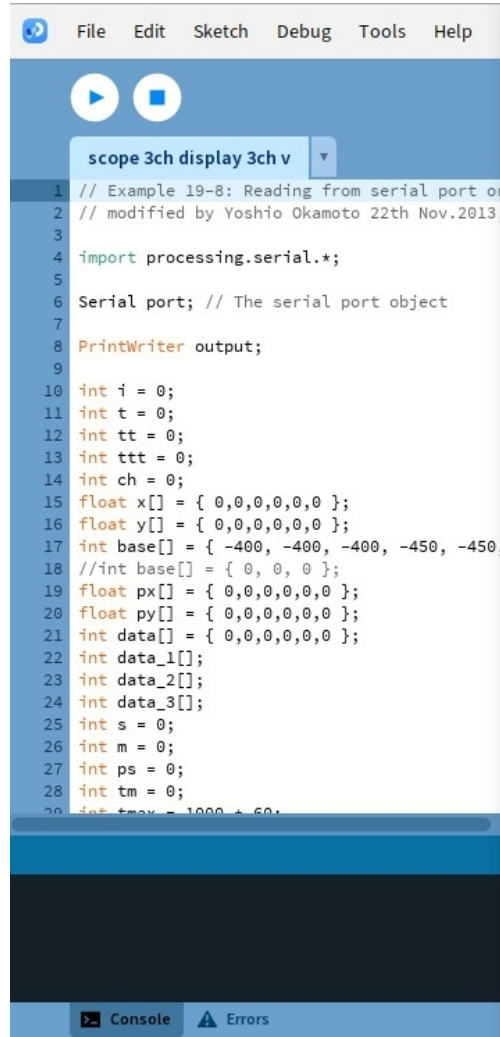
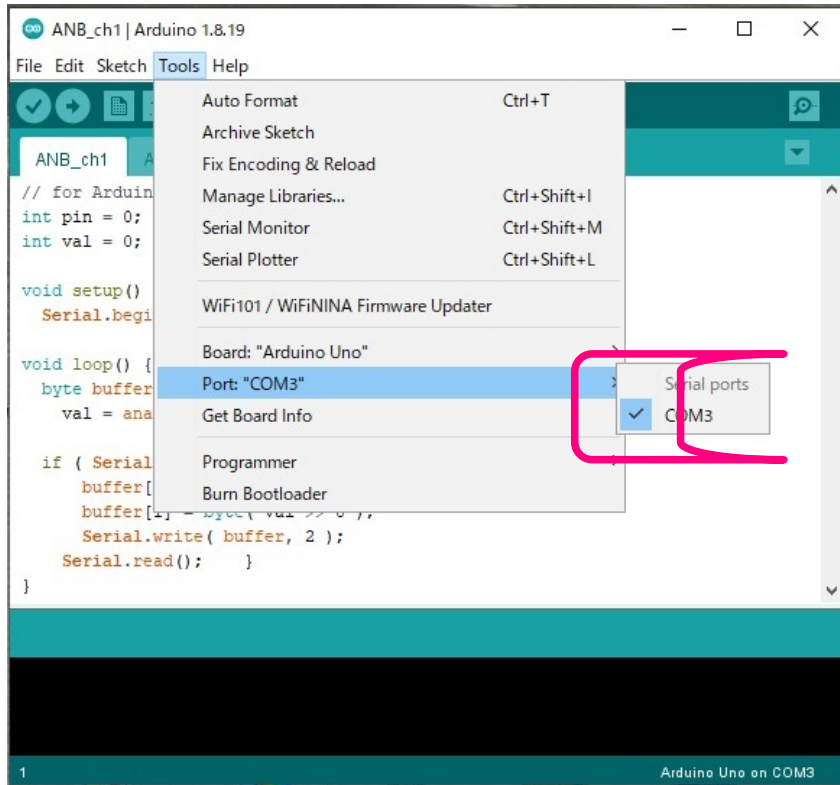
ALL 3 channels use same circuit pattern
And select any channels to use your choice
We colored signal lines; 1ch: water blue
2ch: green 3ch purple in my Processing code

Arduino Uno or compatible

If compatible use, you need to install
CH340 driver on PC

Softwares

- Arduino IDE: serial port (com number)
- Processing: increase Max memory (4 - 8G)



PC trouble

- No use power shut down or set free from sleep mode
- If some trouble, Reset PC and restart again.
- CH340 driver install (only at the beginning)
- 1) Arduino IDE: XXXXX3ch.ino → checking serial port
- 2) Processing: XX_seis.pde (before running, set the following memory set up)
- To set a large memory area 4G to 8G ← preference menu

Use as a teaching tool

- Explain the whole mechanism of seismograph system
- Sensor + Pendulum + Recording system
- Difference between Horizontal pendulum and Vertical pendulum
- What is a free period of pendulum?
- And the relation between ground motion and pendulum motion
- How to record foreign earthquakes clearly?
- What place is suitable for seismic observation?
- Make your own seismograms for classroom exercises!