[G05-P03] A Hands-on Seismometer Construction Workshop at a Thai Science High School (II): Classroom Practice and Evaluation

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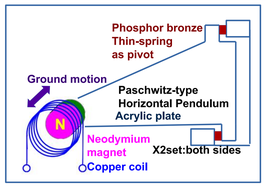
Overview

During the workshop, participants assembled a simple horizontal seismometer, soldered the amplifier board, and set up PC observation software. They also learned basic procedures for adjustment and calibration, and discussed methods for collecting and interpreting seismic data in a school setting. The overall system design is based on Okamoto and Nemoto (2023). The activities emphasized active participation and collaborative problem-solving rather than lecture-based instruction. To evaluate the effectiveness of the workshop, a questionnaire survey was conducted among participating teachers after the session. The responses indicate that the workshop was well received and perceived as educationally effective, particularly in increasing confidence in handling observational instruments and incorporating geophysical observations into classroom practice (details will be presented in the Part 1 oral session).
This poster highlights practical aspects of the workshop, including time management, instructional sequence, and common difficulties encountered during construction and adjustment. These observations are presented as lessons learned that may inform similar workshops in other educational contexts. Ongoing post-workshop support is planned to enable future observations at participating schools.

Outline of WS System



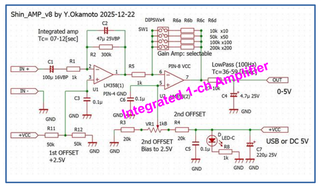


Table.1 Coil and magnet dimension
φ0.25mm φ50mm Ave radii 1500 turns
φ20mm x 25mm Neodymium magnet

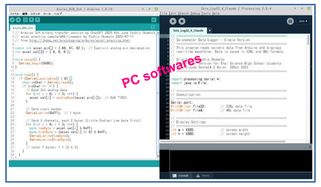


Fig.1 Block Diagram: Electro−magnetic sensor + Integrated Amplifier + ArduinoUno as AD 10bit converter + PC (Arduino IDE + Processing)

Skelton Seismometer

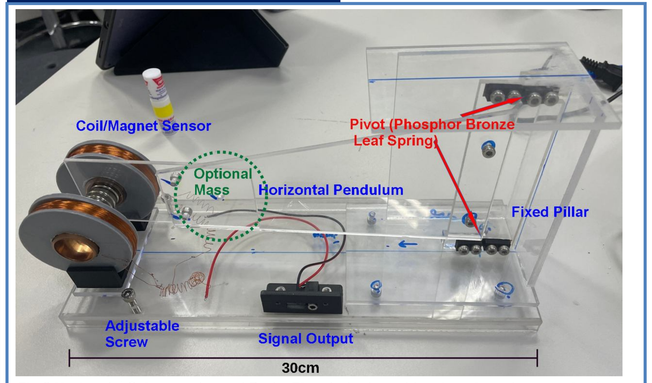


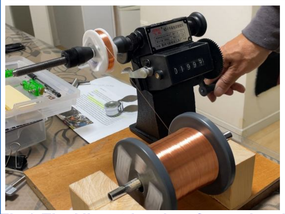
Fig.2 Horizontal Seismometer and Parts. The students and teachers have to assemble from the parts already prepared

Parts for WS System

Our workshop seismometers is based on Okamoto & Nemoto (2023)
<Magnet> Circular NdFeB permanent magnets (φ20 mm, 5 mm thick) serve dual purposes as both the magnetic source and the pendulum counterweight. Five magnets are stacked and fixed to an acrylic pendulum plate by magnetic attraction.
<Coil> Urethane-coated copper wire (0.2–0.26 mm diameter) is wound to 1500–2000 turns onto 3D-printed bobbins (inner diameter: 28 mm, outer diameter: 60 mm, winding width: 10 mm). A copper pipe (wall thickness: 1 mm) inserted into the bobbin core provides eddy-current damping. Figure 2 illustrates the coil winding configuration.
<Magnetic circuit configuration> The magnet pole directions and coil winding directions are identical, so the EMFs induced in the two coils add constructively, yielding twice the output of a single-coil design.
<PCB board> PCBs were fabricated by JLCPCB (China) and hand-soldered by students and teachers.
<A/D converter> An Arduino Uno R3 or equivalent is used for 10bit A/D conversion.
<Logging Software> ArduinoIDE and Processing are employed, based on the algorithm used since our initial prototype (Okamoto, 2000). The program displays signals in real time; after each one-hour session, the display image and 10-bit A/D data are saved to the HDD before the next session begins automatically. Periodic checks are necessary to ensure continuous 24-hour operation.

Preparing Parts

Acrylic parts:
5mm thick acrylic plates are cut using a large CO2 laser cutter at PCSHS Mukdahan manufactured by Shenzhen Reliable Laser Tech Co.,Ltd, which can cut max thickness < 15mm. Some tapping (4mm) and gluing are made by WS students and teachers. (See discussion).
Coils: 3D printing plastic bobbin and hand-winding tool below. (the dimension is Table.1) These parts were made before the WS by Mr. Pao. (Laboratory teacher)
We have already prepared pre-made versions of several components, including the PCB, in case the students failed to assemble them correctly. This proved to be very useful. (See discussion).



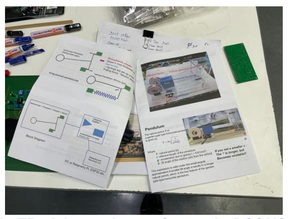


Fig.3 TL: All part in a box for each school
BL: A Hand-Coil Winder
TR: A Large Laser Cutter At PCSHSM
BR: Production Guide

Results and Discussion

The workshop held at PCSHS Mukdahan was successfully conducted over three days, and all participating school teams completed the assembly of functional seismometers. To the best of our knowledge, this may be the first workshop of this kind for secondary school students and teachers in the world.
Some technical difficulties were encountered. The most critical was a sudden signal drop caused by a cable-connector miss match, which was identified and resolved by the dedicated workshop staff. The construction of acrylic structural parts also proved challenging due to the precision required. So, we prepared some alternative parts. We are currently testing a solution that uses hot-melt nuts and soldering iron.

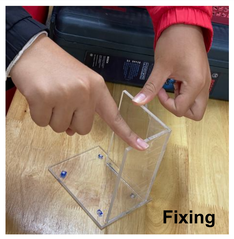
These experiences suggest that pre-assembling mechanically demanding components before the workshop and allowing extra time for troubleshooting would benefit future events. Ongoing post-workshop support is planned to sustain observations at participating schools. We are currently testing a solution using heat-set threaded inserts installed with a soldering iron.

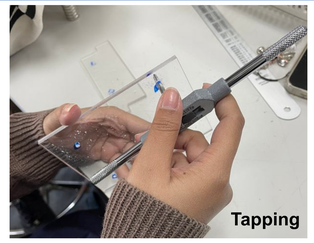
Acknoledgments and References

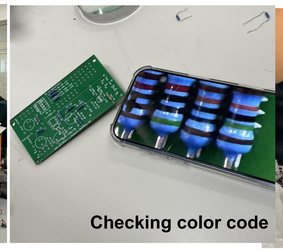
<Acknowledgments> This project is supported by WNI WX Bunka Grant 2025. Also, we thank to all PCSHS Mukdahan WS Staffs and WS participated school members.
<References> Y. Okamoto(2000): GeoSciEdIII Sydney Proceedings. http://yossi-okamoto.net/Old_HP/Futen/2000_Sydney/Seismograph.pdf
Y.Okamoto and H.Nemoto (2023): 77th Conference of the Japan Society for Earth Science Education in Shiga Poster. http://www.yossi-okamoto.net/2023_Shiga/Shiga_Seis_EG.pdf

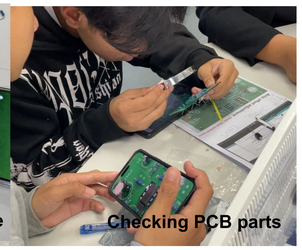
Photo Album

Day 1 Acrylic Body Construcion + PCB Soldering

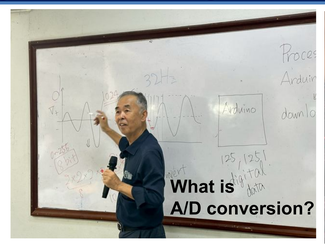


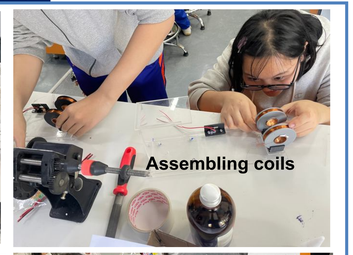


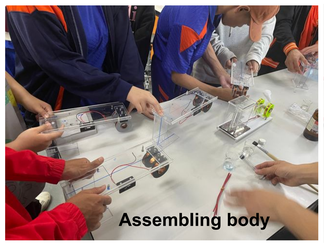


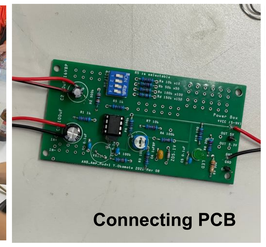


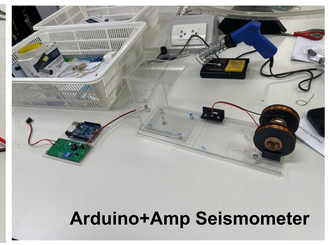
Day 2 Principle of Signal Processing and Whole Body Assembly











Day 3 Signal Connection and PC Setup