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Low-Cost and Easy-Made Horizontal Seismometer with Arduino for Educational Use -Demonstration and Observation-

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We have already developed an easy made seismograph system using Arduino as an AD converter for classroom demonstration [1][2]. A sensor is made from cheap materials purchased from DIY stores/online. The Fig.1 shows a detail of this sensor with an additional brass mass.

This time its structure gets improved and specialized for routine observation of local and foreign earthquakes. A bifilar horizontal pendulum (3m long) is composed of two nylon wires and two L-shaped iron bars + neodymium magnets. A rounded coil coupled with the mass of pendulum produces signals proportional to ground velocity. An integrating amplifier assembled on a solderless breadboard is used for classroom demonstration and soldered on a printed circuit board for routine observation. The signal from the sensor is integrated, amplified, and introduced to Arduino for AD-convert. After guided via USB port to the PC, digitized signals are displayed and saved with a soft-ware written in Processing language. This JAVA like source code can run on any platforms such as Windows, Mac-OS, Linux even on Android tablet. Two of these rectangular placed sensors are operated for routine observation in our laboratory. The pendulum is hanged from a seal along with the room wall in order to avoid air convection.

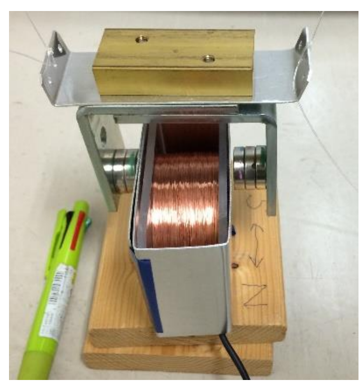

Fig.1: Sensor with a brass mass

An aluminium plate surrounding the coil causes eddy current to damp the pendulum movement (see Fig.1) .

The apparatus now being used; 2 sets of 3 [sec] free period pendulum + high-gain integrated amplifier; the system is tuned up for local and foreign earthquakes. Our system without PC costs around 100USD.

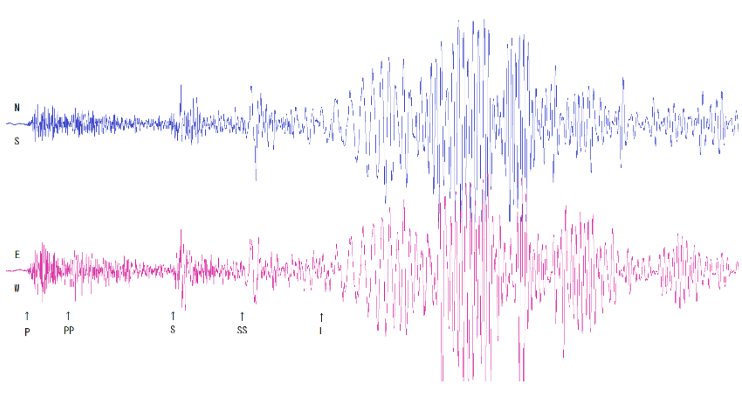

Fig.2: The Nepal M8.4 earthquake, epi-central distance of

The Fig.2 shows a seismogram of the Napal M8.4 earthquake on 25th Apr.2015. P, PP, S, SS phases and reverse-dispersed surface wave are clearly recorded in spite of a cheap cost of the assembly. The back draws of our system are;

1) Weakness for air convection

2) Rotational instability of the sensor.

Therefore, we begin to improve our system. Regards these problems, our system has a significant role in classroom or school for the use of both demonstration and routine observation. Students learn about seismometer and seismology from using our system. The comparison of our system and the standard seismograph will be presented at the conference.

References:

[1] Okamoto, Y (2015) :*Nawifuru,* **102**, 4 (in Japanese)

[2] Okamoto, Y. and A. Ito (2015) :*7th GeoSciEd International Conference* ***Volume of Abstract.*** 16