VIII GeoSciEd 2018 – 8th Quadrennial Conference of the International Geoscience Education Organisation (IGEO)
– Geosciences for Everyone –
VIII Simpósio Nacional de Ensino e História de Ciências da Terra / EnsinoGEO-2018
– Geociências para Todos –
Campinas – Sao Paulo – Brazil, July 2018

"A School Seismograph System at KVIS, Thailand"

- A new construction and its seismograms -

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Introduction

Seismograph is a fundamental tool for geoscience, and yet there are only a few attempt to use a seismograph using hand-made sensors as a teaching tool at high-school level. It is hard to motivate students in Thailand to study earthquake or related disasters, because Thailand rarely has earthquakes. We have been developing handmade seismographs for school use during the past two decades (eg. Okamoto, 1999). A few years ago, we completely refreshed our system by using new strong magnets, a modern micro-controller and a sophisticated programing code (Okamoto, 2016, Okamoto and Ito, 2014). This new system is now successfully installed at Kamnoetvidya Science Academy (KVIS). The system has been in operation to continuously monitor daily seismic activities on this campus. Also, many seismograms were periodically generated for teaching geoscience. The system has detected several foreign earthquakes already. These are, for examples, the 2017 North Korea nuclear test and the Mexico M8.1 2017 earthquake. This poster shows details of our system and some interesting results generated.

Instruments and softwares

The seismograph consists of i) sensor ii) pendulum iii) damper, and iv) logging system. An overview of our all hand-made system is shown in Fig.1.

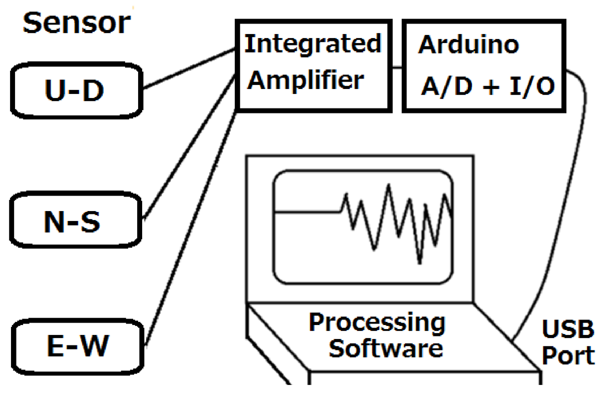

Fig.1 Overview our system

<Hardware>

1) Electro-magnetic sensors: a copper coil and strong neodymium magnets (Fig.4)
2) Pendulums: modified Ewing type (vertical) and Swing-gate type (horizontal): Fig.2.
3) Pivots: thin phosphor bronze plates (0.1 mm), crossed in vertical system (Fig.2)
4) Damper: an aluminum plate (0.5 mm thick) and an electro-magnetic damping:Fig3.
5) Integrated amplifier (Fig.4) + A/D converter built in "Arduino Uno"

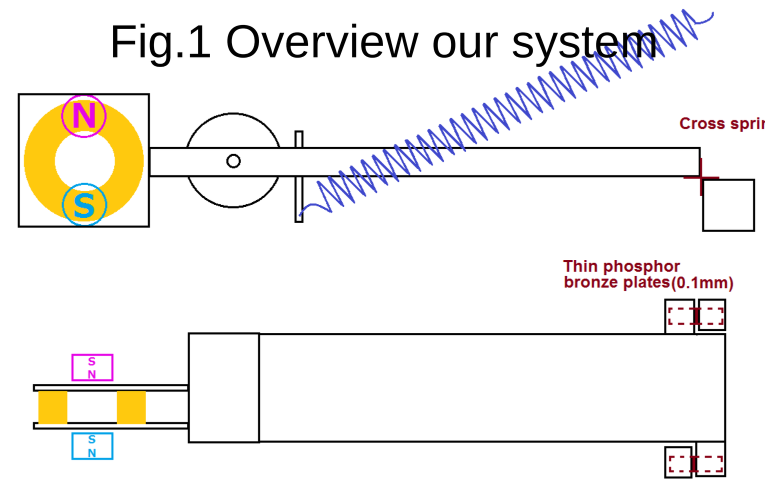

Fig.2 Pendulums: vertical and horizontal

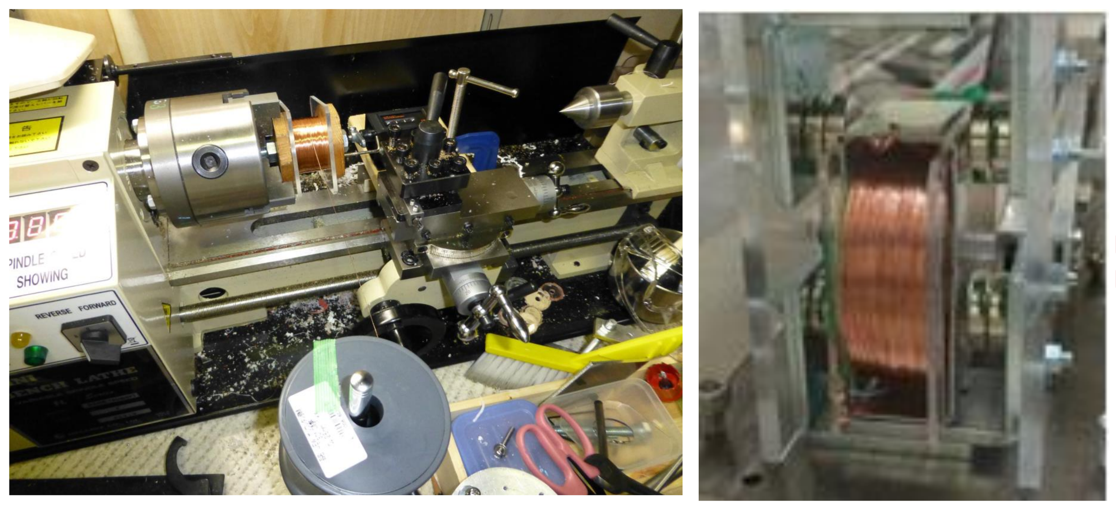

Fig.3 Copper coils with a damper plate and neodium magnets

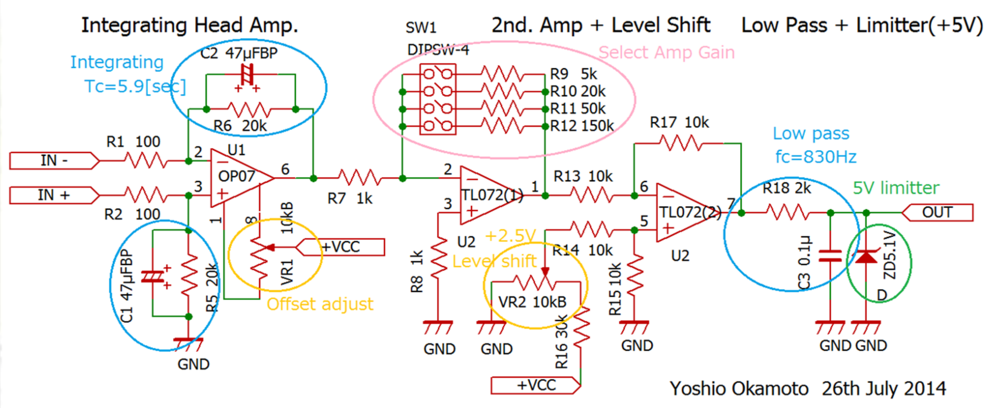

Fig.4 Integrated Ampifire with OP amps

<Software>

1) Programing languages: Arduino IDE + Processing
2) Data are introduced via USB port.
3) Continuous real-time display with 1 sec time-marks; 64 Hz sampling rate, 30 sec signals x 60 lines = 30 min display signals = one recording unit
4) Save data: digital.txt + image.dat of 30min.
5) Programs are running on Linux Mint OS: Fig.5-7

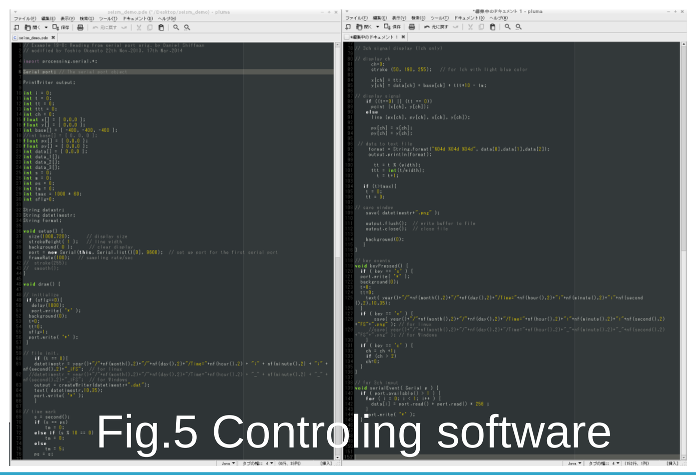

Fig.5 Controling software

Results and Discussion

Our system was installed in early September 2017. In the trial recordings several interesting signals were recorded.

1) The use of integrated amplifier is to show displacement ground motions instead of velocity outputs from a common electro-magnet sensor.
2) The seismic noise level of our campus is quite low by a stable hard granite base, and also for being far away from seaside. Therefore, weather based long period tremors and artificial tilts are recorded.
3) The detecting limit of earthquakes is less than M4.0 for local earthquakes and M6.5 for foreign earthquakes.
4) The M6.3 North Korea nuclear test signal was clearly recorded in the vertical component. The signal shows a characteristic initial upper phase of a nuclear test.

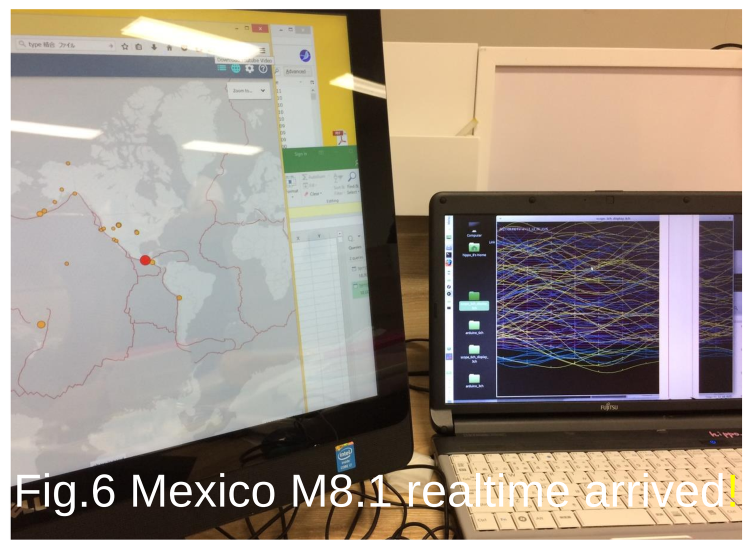

Fig.6 Mexico M8.1 realtime arrived

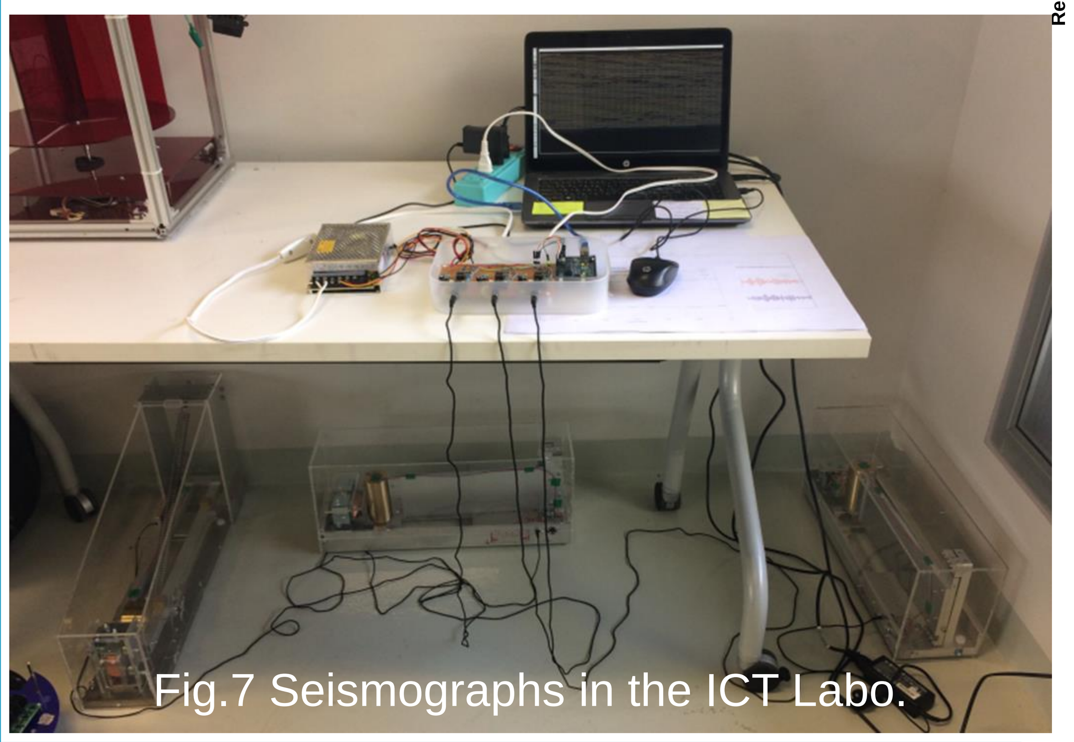

Fig.7 Seismographs in the ICT Labo.

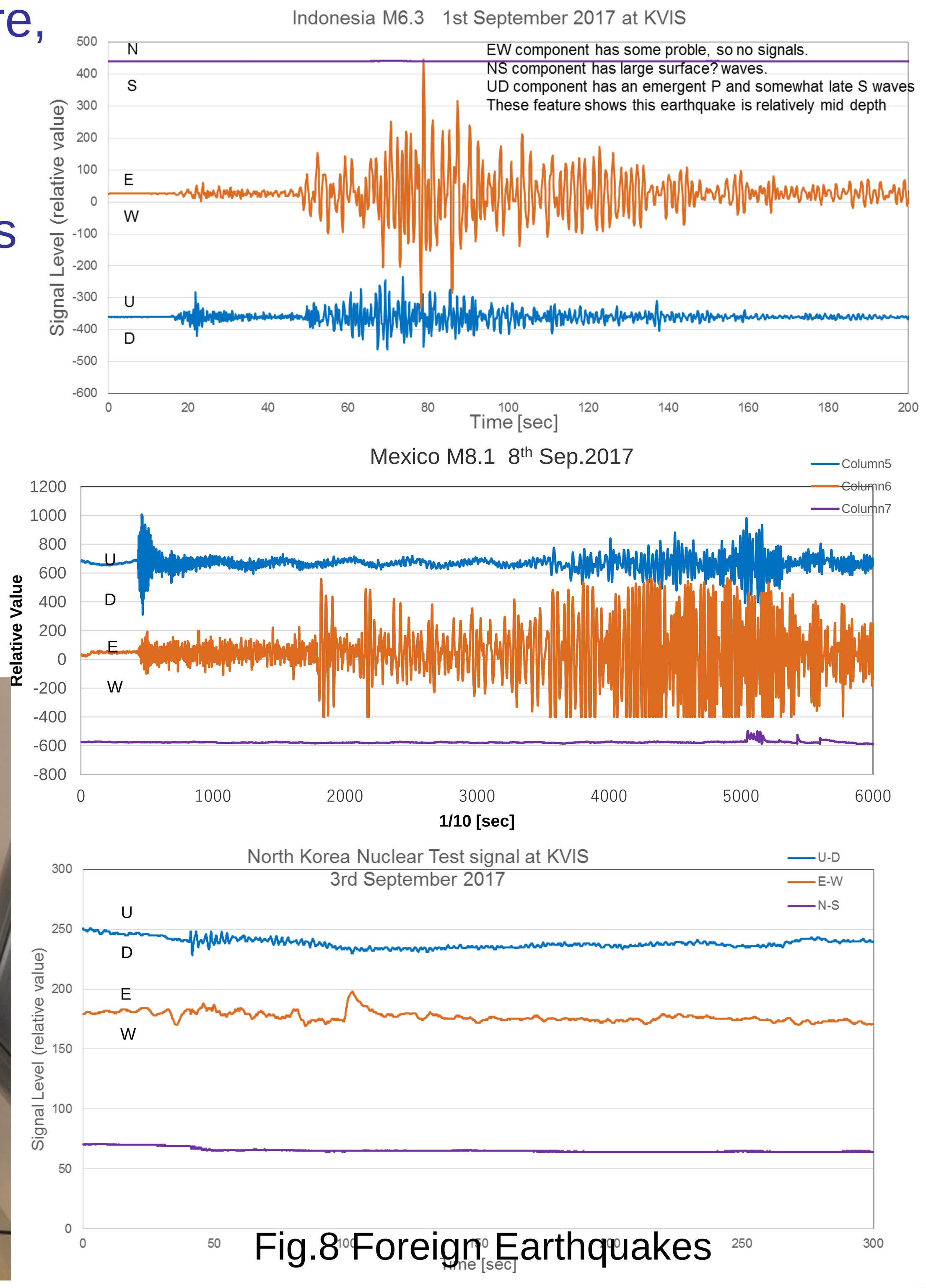

Fig.8 Foreign Earthquakes

Conclusions

For educational use, new seismographs, all hand-made modern electro-magnetic sensors + Arduino signal processing unit were installed in a Thailand science high school. The system are successively recording daily weak noises and foreign earthquakes.
Our campus is suitable for a seismic observation due to a hard ground base. We will develop new teaching materials for educational seismology using our own seismograms in the near future.

Acknowledgements

Thanks go to Dr. Thongchai Chewprecha (Previous KVIS principal), and Dr. Pailin Chuchottaworn (The chairman of the KVIS governing board) who strongly support and have been giving encouragement continuously throughout this work. Dr. Thanit Pewnim (KVIS senior adviser) read our manuscript, provide useful suggestions and prepared the observation site. Mr. Theparak V Palma (KVIS physics laboratory teacher) maintenances of our seismograph system. This work was partly supported by Kakenhi No. 25350200.

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7th International conference on Geosci-ence Education (GeosciEdVII) Abstract.

Above references and details of my seismograph system will be soon available in my website: **http://www.yossi-okamoto.net/**