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A very low-cost and adaptable DIY seismic station

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With the advent of prototyping platforms and low-cost computers, geological do-it-yourself components and sensors can be quickly and inexpensively built. The design of the prototype can also be improved over several iterations, from high-resolution magnetometers to vertical electrical sounding instruments, opening new opportunities to gather data in the field or in the lab.

One of the possibilities in the field of DIY geology is seismological research, because the availability and diversity of the parts used can come in handy when developing an instrument. Also, they are really easy to build without a very deep electronics background.

Although the range in low-cost seismometers is usually restricted to local seismology, induced seismology or human activities, our approach is able to record data with sampling rates up to 500 Hz. It can record and analyze data with a resolution of 16-bit, but it can be regulated to reach 24-bit if needed. Data transfer can operate all-day with low power consumption, using around 1-Amp per hour, or even less, depending on the final setup chosen.

Our first seismograph (<100€ consists of a vertical geophone with a natural frequency of 10 Hz, an Arduino or similar board, a 16-bit ADC capable of amplify and convert the output signal of the geophone. The latter, connected to a Raspberry Pi, gathers the data from the geophone using a Python script, slices it in 1-hour intervals and draws waveform and frequency spectrum graph for quick analysis with Matplotlib, a common graphing library in Python.

The data can be gathered using several methods: If a Wi-Fi network is available, the instrument can be directly connected to the Internet and the data uploaded in real time. If there is no such connection available, a GSM shield can be used to upload the data, and in the worst-case scenario, the data can be accessed directly on the field via Wi-Fi or Ethernet connection if the location of the sensor make unable to connect via WiFi or GSM.

Obviously, there can be also different configurations to fit different needs: From horizontal geophones, to the use of accelerometers to substitute the geophone and miniaturize even less the size of the seismic station. Also, the data can be gathered only by an Arduino board, but then it needs a card reader/writer and a real-time clock (RTC) circuit in order to correctly timestamp the data.

In the first semester of 2016, we plan to build several units and deploy them in the field over the Bajo Segura Fault (Spain) and test them over different conditions to better assess the quality of the data.