**Retrieving Signals from a Noisy World: How Seismometers Work**

**When:** August 9th, 2021, 9am-1pm MT

**Where:** At the zoom rooms: prior to the GAGE-SAGE workshop 2021

**Timing estimates:**

* 4 hours = 240 min
* 5 min introduction
* 10 min at the end for summary, wrap up, and Q&A
* 10 min for poll questions

Binder Link for Python Jupyter Notebook Exercises: [**https://mybinder.org/**](https://mybinder.org/)

* **Note you will then load the exercises from this Github Respository:** [**https://github.com/aringler-usgs/how-seismometers-work**](https://github.com/aringler-usgs/how-seismometers-work)

1. **Click the binder link**
2. **Load the Github Repository (copy the URL above)**
3. **Hit “Launch”**
4. **Have fun playing with seismic data!**

**Agenda:**

* **Welcome, Motivations, and Introductions** (5 min)
  + Couple of slides about our backgrounds and motivation for the workshop
  + What to expect, etc
* **Part I: Seismic sensors and their structure** (Akram Mostafanejad, PASSCAL)
  + Seismic sensors in time; physics and history review
  + Seismic sensors; the sensing elements
    - Short break and quick look at Python jupyter notebook **exercise**
  + Electronic force balance seismic sensors
    - Q&A
* **Part II: Seismic Instrument Response and Response Removal** (Rob Anthony, USGS)
  + Introduction to Seismic Instrument Responses
  + Where to find Responses and how to read RESP files
    - Useful Links
      * **QSPA Station Information from IRIS**

[**http://ds.iris.edu/mda/IU/QSPA/**](http://ds.iris.edu/mda/IU/QSPA/)

* + - * **QSPA GS-13 Information**

[**http://ds.iris.edu/mda/IU/QSPA/85/HHZ/?starttime=2011-01-18T00:00:00&endtime=2599-12-31T23:59:59**](http://ds.iris.edu/mda/IU/QSPA/85/HHZ/?starttime=2011-01-18T00:00:00&endtime=2599-12-31T23:59:59)

**QSPA GS-13 Response File**

* + - * [**http://service.iris.edu/irisws/resp/1/query?net=IU&sta=QSPA&loc=85&cha=HHZ&starttime=2011-01-18T00:00:00&endtime=2599-12-31T23:59:59**](http://service.iris.edu/irisws/resp/1/query?net=IU&sta=QSPA&loc=85&cha=HHZ&starttime=2011-01-18T00:00:00&endtime=2599-12-31T23:59:59)
  + **Exercise 1** on Response Removal (Python Jupyter Notebook )

**In case you are interested in what generated this seismic signal:**

**USGS Event Page for M 6.0 Balleny Islands Event** [**https://earthquake.usgs.gov/earthquakes/eventpage/us7000clt8/executive**](https://earthquake.usgs.gov/earthquakes/eventpage/us7000clt8/executive)

* + **Exercise 2** using NRL to make your own response and verify that you got it right! (Python Jupyter Notebook)
    - Use Nominal Response Library (Thanks Mary Templeton!!!) for this exercise: [**http://ds.iris.edu/NRL/**](http://ds.iris.edu/NRL/)
    - Here’s the earthquake you’re looking at to verify your response:

[**https://earthquake.usgs.gov/earthquakes/eventpage/us7000bq10/executive**](https://earthquake.usgs.gov/earthquakes/eventpage/us7000bq10/executive)

* **Part III: Instrument Specifications and why we should care** (Adam Ringler, USGS)
  + What do we want to record?
  + Basic Specifications
  + How do they relate to modern seismology
  + Beyond specifications
  + **Exercise** on self-noise (Python Jupyter Notebook)