SnT 2025
8 SEPTEMBER ONLINE ONLY
9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

P3.5-468

Generation and utilization of synthetic seismograms with the Waveform Simulation Framework

Robert W. Porritt and Louis Quiñones

Sandia National Laboratories (SNL)

INTRODUCTION AND MAIN RESULTS

This framework provides an intuitive interface for seismologists to design, run, and analyse seismic simulations.

This technology is designed to improve nuclear-test-ban monitoring by facilitating hypothesis testing of new methodologies on seismological waveforms with perfectly known ground-truth. It provides the toolkit for seismologists quantitatively inspect events of interest or stress-test emerging algorithms.

SAND2025-11159D

SnT 2025 CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
8 SEPTEMBER ONLINE ONLY
9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE

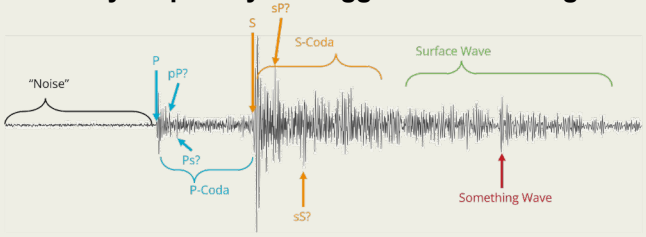
Generation and utilization of synthetic seismograms with the Waveform Simulation Framework

Robert W. Porritt and Louis Quiñones
Sandia National Laboratories (SNL)

P3.5-468

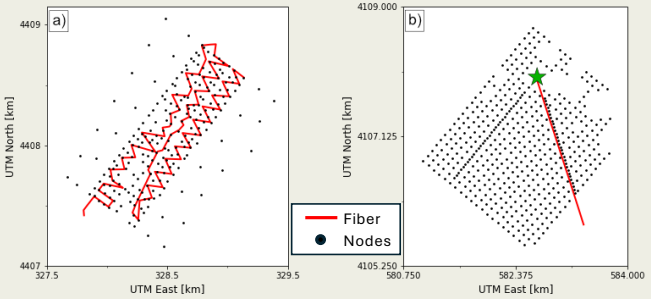
Motivation

How do you quantify the wiggles on a seismogram?



(above) Example seismogram for a Marsquake

How would you design a seismic network?



(above) Two example networks with both Distributed Acoustic Sensing (DAS) and traditional geophones. (a) Brady Hot Springs Porotomo experiment. (b) SPE Phase II, Dry Alluvium Geology.

"It works in practice, but how is it in theory?"

Framework

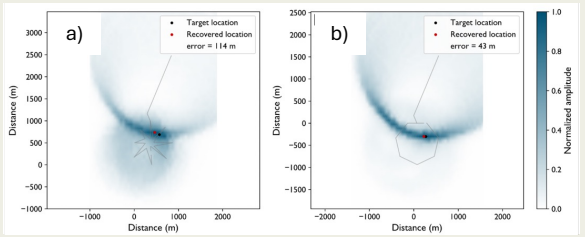
A framework is a system of interrelated programs and libraries that can be used to build application specific software.

It allows an individual to utilize software via an intuitive user interface without detailed knowledge of how the underlying software works.

The WSF consists of 5 Python classes defined in the table below:

Receiver	A location where the wavefield is sampled.
Source	Event location, moment tensor, source time function, etc...
Model	1D, 2D, or 3D wavespeed, density, attenuation, etc...
Simulation	Run-time, software-specific parameters. Includes error checking.
SimulationCollection	A list of **Simulation** objects. Executed in parallel. Includes output products.

Application



(above) Back-projection results for a synthetic event for two hypothetical fiber geometries. Geometries were defined by point-and-click in Google Earth and imported into the WSF.

"*The Waveform Simulation Framework package is a highly useful and effective tool that prioritizes simplicity without compromising functionality. It's a user-friendly solution that intuitively integrates into existing Python workflows.*" – Thomas Luckie from a summer internship.

Availability

The WSF is currently in final steps for public open source release.

Release includes source code for the simulator, an updated version of PyFK, a 2D CUDA accelerated finite differences method (Li, Helmberger, Clayton, and Sun, 2014 GJI), and example Jupyter notebooks.

SAND2025-11159D

Sandia National Laboratories

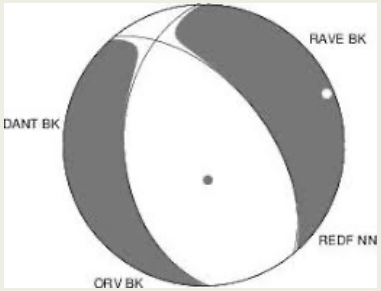
SnT 2025 8 SEPTEMBER ONLINE ONLY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Generation and utilization of synthetic seismograms with the Waveform Simulation Framework

Robert W. Porritt and Louis Quiñones
Sandia National Laboratories (SNL)

P3.5-468

- Our poster is about a new tool called the Waveform Simulation Framework (WSF).
- This tool provides an intuitive user interface for users to run seismic simulations.
- We developed a set of classes, distributed as a python module, that are able to translate from common seismological concepts into inputs to design, run, and post-process simulations.
- The most important result of our work is the lower barrier to entry for new researchers to run seismic simulations.
- If you want to find out more, come over for a chat in front of our poster



SAND2025-11159D

Sandia National Laboratories