SnT 2025 8 SEPTEMBER 9 TO 12 SEPTEMBER
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Developing workflows for the vectorization of legacy seismograms

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INTRODUCTION AND MAIN RESULTS

We embarked on a 5-year project to create online workflows to vectorize legacy data.

In Y1, we:

- reorganized SKATE to meet software best practices, upgraded to Python3, and began algorithmic improvements to meanline calculations.
- Piloted the FOLDS FDSN metadata standard in developing a database schema for legacy data with a few modifications.
- Applied ML to remove metadata from records

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Introduction

The discovery and vectorization of legacy seismic data are two of the barriers to the (re)use of seismic data recorded on physical media. Challenges include imaging the large numbers of records, metadata discovery and curation, and the creation of time series accessible to modern digital data processing methods. Here, we describe and demonstrate progress on the development of an open-source web-enabled data pipeline that aligns with FAIR practices and incorporates emerging FOLDS FDSN data exchange standards for legacy seismic data. The target data sets are the WWSSN scans from the Historical Seismogram Filming Project, scans from the Northwestern University Seismogram Archive Facility and Southern California Seismic Network (SCSN).

Here we describe progress in Year 1.

What are your workflow pain points?

OTHER Y1 IMPROVEMENTS include a data overlay tool and an option to choose an image type (negative film or positive). **FUTURE IMPROVEMENTS:** improving segment connectivity by using meanline extrapolation polynomial fitting for a smooth time series, and using a YOLO model (ML) to detect real-time objects requiring labelled data.

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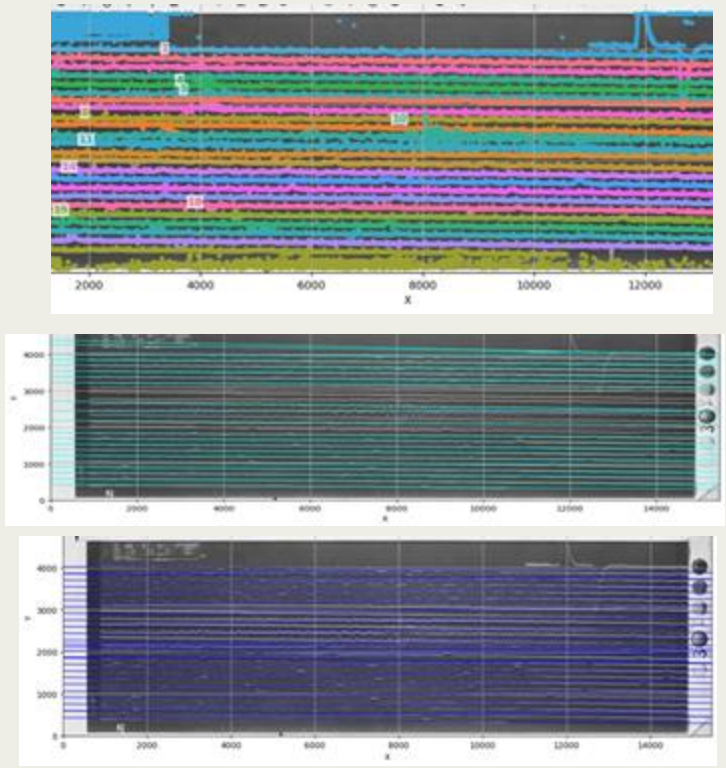
Meanlines

SKATE relies on calculating meanlines through pixel data for proper segment assignments and connection algorithms. Meanlines for well-behaved seismograms can be accurately detected (top).



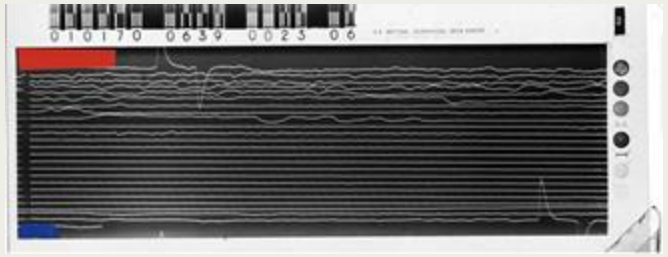
Example of meanline assignment before algorithmic improvements (middle) and after (bottom).

WWSSN film chip scans

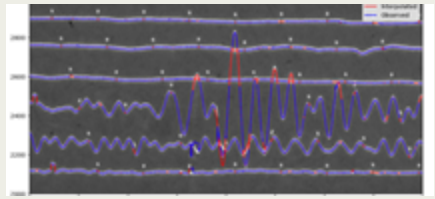
SKATE

Metadata Extraction

The initial goal of this part of the project is to automate this process and interpret them as FOLDS metadata, thus saving time and improving accuracy. We are applying ML algorithms in recognizing the WWSSN film chip scan's dogtag and other metadata.



Examples of labelling efforts using WWSSN film chip scans. Here we identify 2 regions of interest: 1. The dogtag is the primary target (red), and 2. Other regions (blue). Both will be scraped and stored as separate layers before passing to the vectorization algorithms in SKATE.



ALGORITHMIC IMPROVEMENTS here are helping to interpret signal gaps and associate orphan segments.

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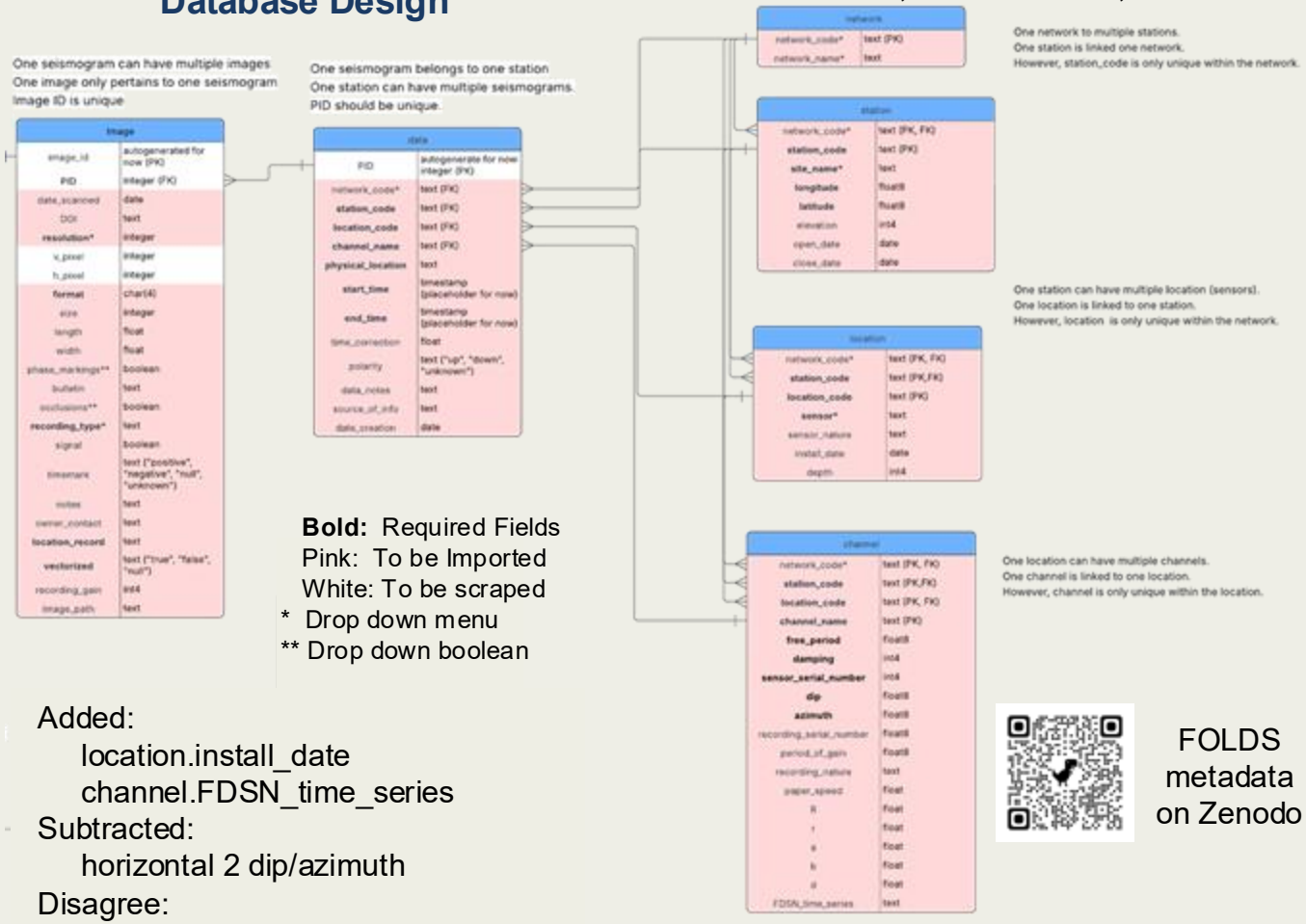
Database Design



Bold: Required Fields
Pink: To be Imported
White: To be scraped
* Drop down menu
** Drop down boolean

Added:
- location.install_date
- channel.FDSN_time_series

Subtracted:
- horizontal 2 dip/azimuth

Disagree:
- "PID" needs further discussion

FOLDS metadata on Zenodo

Analog vs. Digital

Example 1: Instrumentation

WWSSN 3 component SP + 3 component LP

STS-2 triaxial seismometer

Analog - each component is a separate instrument package
vs.
Digital - 3 components can be bundled into the same instrument package.

Example 2: Data packages

Analog - 1 record each day, some metadata on record.
vs.
Digital - miniSEED continuous waveform 512 or 4096 byte.

What other digital concepts do not apply to analog data?
Should time series be "repaired" or similar to digital data, do we allow for signal drop outs?
What about minute markings?

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Legacy Data Resources

Looking for legacy data resources? Start at the Legacy Seismic Data (LSD) website for links to data, software, references and the FOLDS specification.

Have a correction or addition? Contribute directly to the GitHub repository.
lsd-sphinx.readthedocs.io/

SCSN Data Availability

Late Spring we began reorganizing and inventorying the analog records from Southern California Seismic Network (**SCSN**) with records from 1925 -1990's. Researchers may request scanned images from this collection. This corpus will be used in the development of the BP/SD pipeline.

Publish: Special issue

Publish your work using in this **special issue** Analog Seismograms in the Digital Era: Methods, Applications, and Perspectives. Deadline March 1, 2026.
https://link.springer.com/collections/bgbgegjbgd

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https://seismica.library.mcgill.ca/

geodynamica

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