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geophysical data [from nuclear tests]: Which digitization software should I use? How can I leverage the power of AI for forensic analysis of analog data?

Digitization of historic analog seismograms from nuclear explosions is an imperative need for the Nuclear Explosion Monitoring community since most recorded observations of nuclear tests are in analog media and conversion to digital format is resource and time intensive, which requires specific expertise. To assess the effectiveness of available digitization software, we identified four potential algorithms (out of 33 reviewed references) for further testing and developed a Python toolkit for the generation of synthetic analog helicorder records (synthetic generator). Our evaluation of the selected digitization software uses a tiered approach: synthetic records; scanned and previously digitized data; and scanned, undigitized data. The synthetic generator creates data in a manner that faithfully represents the characteristics (and challenges) of analog seismograms: variable trace thickness, time marks (WWSSN, USSR), waveform crossover, etc. As the number of underground nuclear tests conducted during the digital data era is comparatively small, we can use our synthetic generator to produce and augment AI/ML training datasets for machine learning applications. We present our initial results for testing of the selected digitization software packages using synthetic data generated by our toolkit and explore potential applications for nuclear monitoring of data created by our synthetic generator.

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