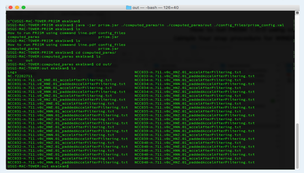
Processing and Review Interface for Strong Motion Data (PRISM) Software Version 2.0

Erol Kalkan (ekalkan@usgs.gov), Jeanne Jones, Christopher Stephens, Peter Ng, Jamie Steidl, Jeff Brody, and Lind Gee

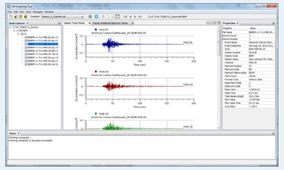
Abstract

PRISM automates the processing of strong-motion records by providing batch-processing capabilities.

The software consists of two components:



A record processing engine (command line interface) composed of modules for each processing step.



A graphical user interface (GUI) for manual review, edit and processing.

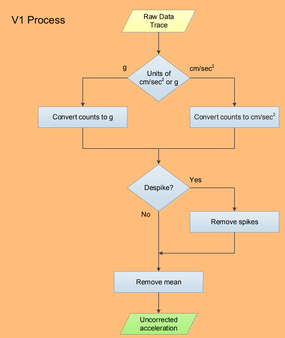
Main Features

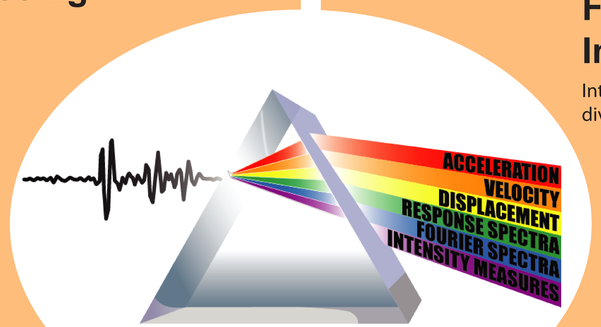
- Platform-independent, modular, extensible and open-source;
- Customizable processing parameters with a configuration file;
- Phase-time and maximum amplitude picking;
- Time-domain mean-removal, integration and differentiation;
- Frequency-domain resampling;
- Acausal bandpass filtering;
- Baseline correction determined from the velocity time series and removed from the acceleration time series in time domain;
- Filtering performed on the acceleration time series in time domain;
- Generation of products that include compatible acceleration, velocity and displacement time series, response spectra, Fourier amplitude spectra, and standard earthquake-engineering intensity measures;
- Log files for quality control and reproducibility;
- For input, currently uses Consortium of Organizations for Strong-Motion Observation Systems (COSMOS) V0 input format with metadata in COSMOS headers; and
- Products in COSMOS data format (V1, V2 and V3).

What's New in PRISM 2.0

- Frequency-domain integration;
- Frequency-domain decimation;
- Auto-detecting spikes and removal;
- Signal-to-noise ratio (SNR) thresholding; and
- Auto-detecting bandpass-filter corner frequencies.

Volume - 1 Processing

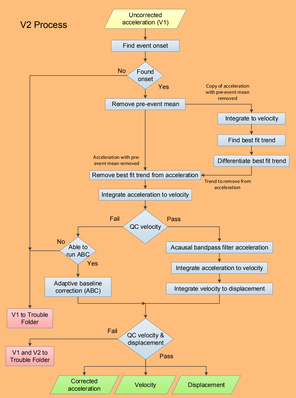




PRISM 2.0

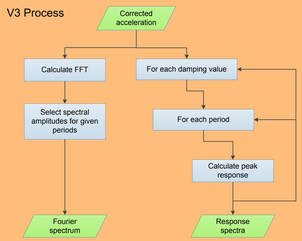
Volume - 2 Processing

Step - 1: Resampling to 200 sps (if needed)
Step - 2: Event onset detection
Step - 3: Pre-event mean removal
Step - 4: First order baseline correction (velocity domain)
Step - 5: QC
Step - 6a: Bandpass filter with acausal filter (acc. domain)
Step - 6b: Adaptive baseline correction (ABC)
Step - 7: Compute acceleration, velocity and displacement.;
Step - 8: Decimate to original sampling rate (if needed)



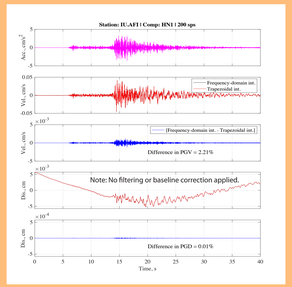
Volume - 3 Processing

1) Pseudo acceleration, velocity and displacement spectra at 2, 5, 10 and 20% damping,
2) Fourier Amplitude Spectrum, and
3) IMs:
- Arias Intensity
- Bracketed Duration
- Duration Interval
- Response spec. intensity
- RMS Acceleration
- CAV



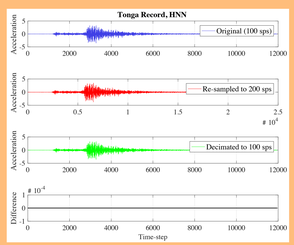
Frequency-domain Integration

Integrates signal in frequency domain by dividing its Fourier spectrum with -iw.

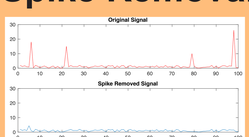


Frequency-domain Decimation

Frequency domain decimation module reduces the sampling rate of a re-sampled signal to its original sampling rate.

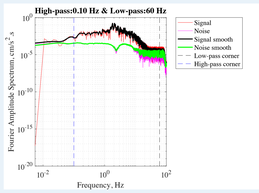


Spike Removal



Replaces spikes (outliers) exceeding the dynamic threshold value by interpolating among previous and subsequent data points.

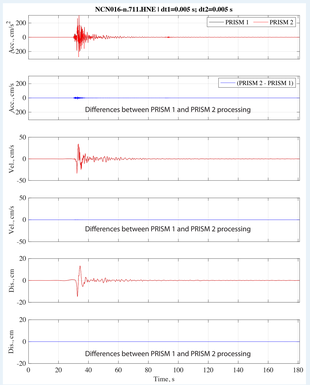
Auto-detect Passband Corners

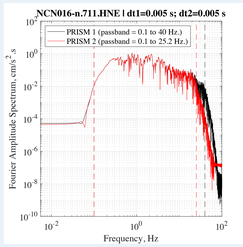


Detects appropriate bandpass filter corner frequencies to be used for Butterworth filtering by using the signal's frequency content.

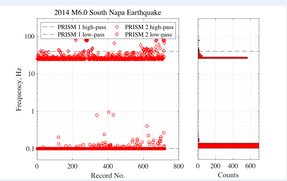
Noise and signal spectra are smoothed using Konno-Ohmachi window.

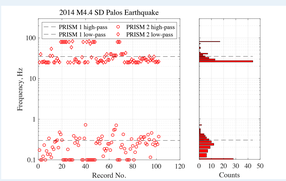
PRISM 1.0 vs 2.0 Processing





Comparing PRISM 1.0 and 2.0 results for component HNE of station NCN016 record from the 2014 M6.0 South Napa earthquake.





Comparing PRISM 1.0 and PRISM 2.0 passband corner frequencies for the 2014 M6.0 South Napa and 2014 M4.4 SD Palos earthquakes. In PRISM 1.0, corner frequencies are retrieved from a look up table based on the earthquake magnitude. In addition to this, PRISM 2.0 also offers auto -detecting corner frequencies.

Take-home Message

PRISM 2.0 provides greater flexibility and increased processing accuracy for strong motion data.