Performance Study of Seismic Stations in the Seismic Tunnel

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Seismic stations with two different digitizers (Q330HR: high-resolution; Q330: standard-resolution) were compared. It was found that stations with a high-resolution digitizer (Q330HR) delivered a lower noise level in a frequency range larger than 1 Hz in comparison to the stations with the standard digitizer Q330. By repeated detection processing, it was identified that significantly fewer false detections were produced using the data from stations with the better digitizer (Q330HR) compared to the ones with the standard digitizer Q330.

In this study we used six stations located in the seismic tunnel at the Conrad Observatory (Fig. 1). Station CONA can be found at the end of the tunnel (purple square), while the other stations are located before a double-wall isolation (green and blue squares). Station CUVW was removed from this investigation because it has a different sensor orientation. All six stations are equipped with the same seismic sensors but different digitizers, i.e. CONA and CXYZ with Q330, while COA, COB, COC and COD with Q330HR. Studies about noise analysis and detection performance were carried out.

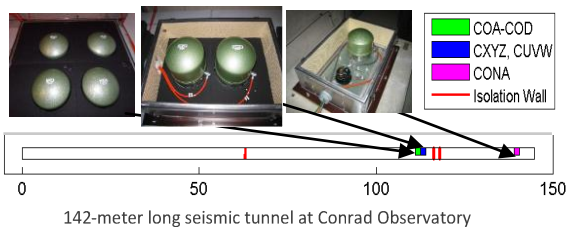

Figure 1: Location of seismic stations used in this paper.

Figure 2 illustrates comparisons of the median noise spectra between the six stations for all three components. The noise levels at the four stations with a better digitizer Q330HR are clearly lower than the ones with standard Q330 in a frequency range larger than 1 Hz.

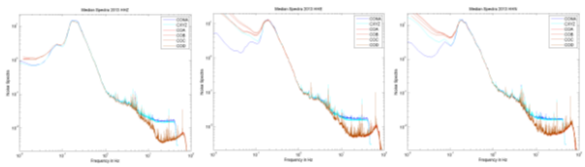

Figure 2: A comparison between median noise levels at the six stations.

Detection processing was repeated with data from January to November in 2013 by using the same configuration as the one utilized in our automatic data processing. Detections found by the reprocessing were compared with the confirmed arrivals in our database.

Table 1 lists statistics for all detections (column "All"), false detection ("False") and rates of false detections (last column). The results in Table 1 can be easily separated into two groups: the first group of CONA and CXYZ with a Q330 digitizer and the second group of COA, COB, COC and COD with high-resolution digitizers. Negligible variations can be found in the same group but significant differences can be easily noticed between the two groups. The rates of false detections at stations CONA and CXYZ are much higher than the ones at COA, COB, COC and COD. This emphasizes that stations with a better digitizer Q330HR produce significantly fewer false detections than the stations with a standard digitizer Q330. Figure 10 demonstrates a graphical summary for detection numbers listed in Table 1.

Table 1: Results of detection reprocessing.

Station	All	False	False Rate
CONA	37876	34307	90.6%
CXYZ	36175	32694	90.4%
COA	11259	8950	79.5%
COB	11198	8888	79.4%
COC	11215	8906	79.4%
COD	11263	8954	79.5%

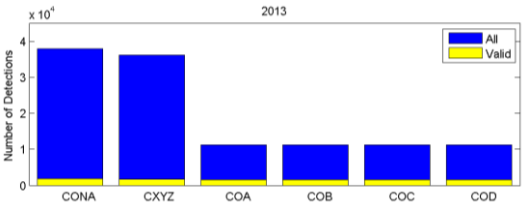

Figure 3: False detections of six stations.

In summary, high resolution digitizer can well improve seismic station performance, i.e. lower noise level and better detection capability.

Reference:
Y. Jia, N. Horn, R. Leonhardt, Improving Station Performance by Building Isolation Walls in the Tunnel, EGU 2014-3312, EGU, Vienna, 2014.

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