

Autoencoder-based feature extraction for the automatic detection of snow avalanches in seismic data

Andri Simeon et al.

Referee Comment

This manuscript develops autoencoder derived seismic attributes and engineered seismic attributes as features in a random forest classification detection of snow avalanches. The results suggest that the autoencoder derived attributes perform as well as the engineered seismic attributes for event detection. The avalanche detection method is reported to be potentially used as an operational, near real-time avalanche detection system, though the relatively high number of false alarms requires further improvement. The work is presented with respect to the previous studies employing machine learning for seismic event detection while highlighting their significant and novel contribution of unsupervised feature extraction. I found the paper to be informative and complete in analysis and have been satisfied by the authors' responses to the initial review which improved the methodological development and comprehensibility of the work.

Comments:

Line 6: "Therefore, we compiled a dataset of seismograms recorded with an array of five seismometers..." This sentence seems a bit disconnected from the main ideas presented. Is this statement intended to link back to "Monitoring snow avalanche activity is essential for operational avalanche forecasting..." or "Still, automatically distinguishing avalanche signals from other sources in seismic data remains challenging." I think the intent could be clarified by replacing "Therefore" with a descriptive intro to sentence like, "Because of the inherent complexity of interpreting signals traveling within the subsurface, we utilized an array of five seismometers..." This example expresses the importance of having an array of seismometers.

Line 104 – 106: Feels like a run-on sentence. Consider the revision, "Additionally, the site was equipped with a Doppler radar and three automatic cameras to obtain independent validation data, including accurate release times and information on the type and size of avalanches, provided favorable weather conditions."

Line 109- 110: "The cameras automatically photographed all surrounding slopes every 30 minutes (Fig. 1)." Consider including one sentence detailing how the photographs were utilized. Manually inspected as a corroboratory inspection of radar or other data source detections, or automatically reviewed as an independent method? This is mentioned on lines 113-114, but not explicitly.

Line 132: What is exactly meant by ground velocity? The derivative of the seismic displacement? Just a bit more detail on this method would be helpful.

Line 232: “As activation function” → “As an activation function”

Line 282: “Therefore, we used the three train folds” → “Therefore, we used the three training folds”

Line 306: Similarly “train” → “training”

Line 307: “weigh” → “weight”

Line 465 “Tough” → “Though”

One thing to note: Between the Engineered Feature and AE feature avalanche detection, which had comparable recall values, were the same avalanches detected? Could the implementation of both SAE and engineered feature detection further increase the detection capability. For if they detected the same amount of avalanches, but different ones, perhaps this increases the overall detection. This analysis is explicitly missing, but could provide additional insights to the differences of the detection methods. Perhaps this is something you have already investigated, but did not note in the manuscript. Figure 13 touches on this conceptually, but it is still hard to discern if the false positive detections stem from different events or not.

With Regards,

Tate Meehan