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Improving Classification Performance of Continuous GNSS Stations Using a Combination of Human and Machine Learning

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Abstract:

The increasing development of GNSS techniques enables solving geodetic problems on both local and global scales. Parallelly, complex algorithms have been proposed and can also be solved well by Machine Learning (ML). However, ML techniques are sometimes not sensitive enough to gain results with a high probability for some cases, like sparse data or non-stationary GNSS time series. In this study, we use a combination of Human and Machine learning (H&M) to improve the classification performance of continuous GNSS stations. First, 427 permanent GNSS stations are obtained from the EUREF network to train ML models. The models are then applied to classify the quality of 939 continuous observation stations from two projects, EIFEL and IPOC, carried out by the German Research Centre for Geosciences (GFZ), Potsdam, Germany. Next, we independently validate the ML models' reality through a MATLAB program, GNSS metadata, and seismic data. Finally, all data of these 1366 stations are used to re-train the ML models. The main criteria to classify are the number of outliers, jumps in GNSS time series, root mean square errors, observation time-spans, and stability of the crustal motion velocity fields. Applying the approach of the H&M combination improves the performance of the ML models up to 92% while using only ML methods remains ~68%. These ML-based classification models can be applied to estimate the quality of permanent GNSS stations and to manage big databases. The result is the basis for selecting suitable control and monitoring stations in crustal deformation monitoring as well as in civil and industrial applications.

Keywords:

GNSS station classification, Machine learning, Human & Machine learning combination.