S-onset time automatic picking based on polarization analysis and higher order statistics.

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Automatic *S*-wave onset time identification constitutes a rough problem for the seismologists, due to the increased level of seismic energy by P-coda waves, before the S-wave arrival. Most of the up to now proposed algorithms, are mainly based on the polarization features of the seismic waves. In this work we propose a new simple time domain technique for automatically determining the S-arrival onsets and present its implementation on 3-component single station data. Over small time windows, the eigenproblem of the covariance matrix is solved and the eigenvalue, corresponding to the maximum eigenvector is retained for further processing. We form in this way a time series of maximum eigenvalues, which serves as a characteristic function, whose statistical properties provide an initial S-arrival time estimation. A multi-window approach combined with an energy-based weighting scheme is also applied, in order to reduce the algorithm's dependence on the moving window's length. Specifically, for each S arrival time estimation an automatically evaluated uncertainty index is introduced for evaluating the probability of a false alarm. This quality measure, similar to SNR, is based on an energy ratio estimated on the two horizontal components, into a predefined time section. In this way we conclude to a set of solutions whose weighted mean is the final S-onset time estimation. Automatic picks are compared against manual reference picks, resulting in sufficiently good results, regarding the accuracy as well as noise robustness. In general the proposed method is straightforward to implement, demands low computational resources and the only parameters that have to be set are the lengths of the time moving windows the algorithm uses. Furthermore, it has to be mentioned that the detected seismic signals as well as good quality P-picks are prerequisites to conclude on correct estimations of S-arrival times. Due to its efficiency, the specific technique can be used as a useful tool for processing seismograms obtained by microseismic networks, minimizing the necessity for human intervention.