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Hypercomplex and High-Order Master Event Design for CTBT Monitoring

We consider a hypercomplex and high-order (tensorial) representation of multichannel seismic data as they are recorded by the International Monitoring System of the CTBTO with processing within the context of the corresponding multidimensional model. In particular, we discuss an approach to construct multidimensional master-event waveform templates for cross-correlation-based detection and relative location with the data recorded at multichannel seismic installations, such as 3-C seismic stations and arrays. Hypercomplex number systems are natural cases of representing a 3-C digital seismogram samples requiring however special attention to the underlying axiomatics. Dealing with the composite observations (3-C arrays) may demand higher than 4-dimensional algebras, or some specific grouping of them, so tensor representation of seismic wavefield seems natural in this case. Data processing then would be conducted not on separate waveform projections, but on relatively full multidimensional objects, so tensor operations on the data from the 3C arrays would utilize volumetric spatial wavefield information. Dimensionality reduction of tensor data produces lower order principal components, a basis for the multidimensional waveform templates. Highly effective master events built with the hypercomplex and multilinear SVD provide a good example of introducing multidimensional data models into CTBTO practice. The approach is tested on sets of quarry blasts.

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