Location of seismic events with a single station using Distance Geometry Solvers

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Earthquake location is one of the oldest problem in seismology. With the advent of modern seismic monitoring networks it is possible nowadays to obtain reliable locations also for tiny events. However, there are still many cases where the lack of a dense enough microseismic monitoring network affects the performance of the routine data analysis procedures, limiting the ability to obtain reliable results increasing the risk of wrong interpretations. In this work we propose a novel approach based on Distance Geometry Solvers (DGS) that allow to locate seismic events by using a single seismic station.
DGS are used to solve a Distance Geometry Problem (DGP), consisting in the characterization and study of sets of points based only on given values of the distances between member pairs. The DGP is the one of finding the coordinates of a set of points by using the distances between some pairs of such points. In this work we introduce a new method that allow locate earthquakes using only the inter-event distance between pair of seismic events using one or two seismic stations. This location method requires only four non-coplanar reference locations for which the absolute hypocentral coordinates are known (at least). In order to show the potential of this approach we firstly validated the method with synthetic datasets resembling different cluster geometries. We finally tested the methods with two seismic sequences occurred in California, 1) the Mw 6.0 Napa Earthquake occurred in August 2014 and 2) the Mw 7.1 Ridgecrest seismic sequence occurred in July 2019. We show that our approach provides better results than any other single station location method and when using the inter-event station estimated with two optimally oriented stations the results are comparable to high resolution Double Difference locations based on the use of multiple stations. This method is particularly useful in poorly monitored areas where only a limited number of stations is available.

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