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# Automated hypocenter determination of aftershocks and earthquake swarms

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Various techniques have been proposed to achieve automated hypocenter determination. However, interactive processing by analysts is still necessary to get reliable seismic catalog. When a big earthquake occur, delay in hypocenter determination is often seen, and it makes difficult to grasp the source area of the earthquake soon after the occurrence.

Automated processing methods of earthquake swarms have been proposed (e.g., Horiuchi et al., 1999), in which hypocenter locations are assumed in a restricted area. When the Tonankai and Nankai earthquake occur at the same time, the source area would extend for several hundred kilometers. It would be impossible to assume a limited area of aftershock activity for such large earthquakes. We are developing an automated hypocenter determination system to grasp source areas of large earthquakes soon after the occurrence.

In aftershock activity, successive events occur before the decay of the seismic wave of the previous event. A logic of detecting successive phase was introduced. Two decay time were set in the calculation of the long-term average.

It would be important in the automated seismic processing to distinguish reliable onset times from data which include many onsets due to seismic wave of other events, ground noise, and erroneous phase picks. We use grid search method for locations. Probability fucntion of a origin time is calculated from the assumed location and an observed onset time. Product of probability functions of plural onsets are calculated from data set. Origin time estimation is obtained as time of maximum probability for a grid point. The grid point with the largest probability would be the solution of the hypocenter location. Other evenets can be detected with the same procedure after removing the data of the largest probability.

However, trade-off between an origin time and epicentral distance was seen for cases of one-sided station distributions. Information of S-wave arrival can constrain the origin time. To include information of S-wave arrival, we took in the times of maximum amplitude in the calculation of the probability function of the origin time. We are testing and tuning up the programs.

We used seismic data from the National Research Institute for Earth Science and Disaster Prevention, Hokkaido University, Hirosaki University, Tohoku University, University of Tokyo, Nagoya University, Kyoto University, Kochi University, Kyushu University, Kagoshima University, the National Institute of Advanced Industrial Science and Technology, Tokyo metropolitan government, Shizuoka prefectural government, Kanagawa prefectural government, the City of Yokohama, the Japan Marine Science and Technology Center, and the Japan Meteorological Agency.

Keywords: automated hypocenter determination, observation of aftershocks and earthquake swarms