Development of the Cross-Over convolution method and its application to the aftershock data of the 2000 Western Tottori earthquake

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I have developed an accurate hypocenter location algorithm that is independent of source time function, and focal mechanism. Previous hypocenter location methods (e.g. the DD method) can achieve high accuracy using cross-correlation data. But they require adequate source similarity of pairing events; therefore uncorrelated events are not determined with such high accuracy. Meanwhile, the developed method does not require source similarity, because cross-over convolution (XO) can obtain precise cross-over differential time (XOdt) even in case of different source properties in principle. I examined a synthetic test to compare with the DD method for the estimate of accuracy. Finally I applied the XO method to real data in order to evaluate the effectivity.

For synthetic test, I prepared a hundred hypocenters where locate randomly in 15km-cubic and picked up all hypocenter pairs with intervals within 2 km. The DD and the XO data are made by the calculation of traveltime of the hypocenter pairs. The number of the data are 4015 and 8030, respectively. The initial hypocenter locations for inversions are made by adding Gaussian noise with a standard deviation of 1 km to three components of the original ones. The both results of the DD and the XO methods could achieve the almost original locations. The root mean squares of the distance are 0.036 km for the DD method and 0.031 km for the XO method, respectively. This shows that the both method hardly has a difference of accuracy in use of the ideal data. The accuracy, therefore, would depend on only the quality of the data.

I applied the XO method to the aftershock data of the 2000 Western Tottori earthquake. The waveform data was obtained from the high sensitivity seismogram network Japan (Hi-net). The waveform data generated the DD and the XO data. After the selection of the data with correlation coefficients over 0.8, the number of data obtained is 2585 and 3987, respectively. Although there is not a large difference of the numbers, there would be a difference of the quality. That is because high correlation coefficient does not assume the data quality for the DD method. The XO method show superiority in principle. The relation of the interval and the correlation coefficient indicate that the correlation coefficient falls below 0.8 over 2 km in interval. Therefore, the effective hypocenter interval for the XO method is within 2 km. The relocated locations show several linearments and clusters, which could not be sufficiently identified before the relocation. Several linearments from the central to the north parts of the main fault have nearly ENE-WSW directions. This method has a possibility to reveal the release process of the complex stress field.

Acknowledgements. I thank Dr. Sekine for the approval of his ray-tracing program. Dr. Takuto Maeda and Prof. Takaya Iwasaki gave me useful suggestions. I would like to express my thanks to both of them.