An application of Independent Component Analysis to discover knowledge about the propagation mechanism of Pi 2 magnetic pulsations

Terumasa Tokunaga[1]; Akimasa Yoshikawa[2]; Teiji Uozumi[3]; Tomoyuki Higuchi[4]; Kazuyuki Nakamura[5]; Kiyohumi Yumoto[6]; Yumoto Kiyohumi MAGDAS/CPMN Group[7]

[1] none; [2] Earth and Planetary Sci., Kyushu Univ.; [3] SERC; [4] Inst. Stat. Math.; [5] ISM; [6] Space Environ. Res. Center, Kyushu Univ.; [7] -

We have been attempted to apply Independent Component Analysis (ICA) to analyze Pi 2 magnetic pulsations observed on the ground. Pi 2 magnetic pulsations are irregular and oscillating magnetic variations and observed globally on the ground at the onset of auroral substorm expansion phase. Even in the past five years studies, its generation and propagation mechanisms have been only partly understood. It is thought that Pi 2 pulsations propagate from the epicenter region in the magnetotail to ionosphere by MHD waves. In the previous studies, many observational researches have been done in the magnetosphere and on the ground. The advantage of satellite observation is that we can obtain three-dimensional wave characteristics by in-situ observations. On the other hand, its disadvantage is that we can obtain extremely-limited information for the magnetosphere scale. The advantage of ground-based observation is that we can obtain comprehensive wave structures by globally expanded ground-magnetometer chains. On the other hand, ground-observed Pi 2 signals have all informations associated to generation mechanisms and propagation mechanisms of Pi 2 pulsations and we must separate them. In order to understand the generation and propagation mechanisms of Pi 2 pulsations, it is important to introduce some signal processing techniques that make it possible to redeem those disadvantages.

In the present study, we introduce Independent Component Analysis (ICA) to analyze Pi 2 pulsations. ICA is one of the multivariate statistical techniques that started to be used in the 1990s in the field of signal processing [e.g., Common, 1994]. With ICA, source signals are assumed to be non-Gaussian and statistically independent of each other and estimated by maximizing their statistical independence. It has been successful in resolving observed mixed signals including brain imaging data and voice signals into source signals.