Extraction of the two-dimensional flow pattern and fluctuations from a sequence of auroral images

Shin'ya Nakano[1]; Yasunobu Ogawa[2]
[1] The Institute of Statistical Mathematics; [2] NIPR

Since aurorae are associated with various magnetospheric processes, aurora observation is a promising way to monitor the magnetosphere. Nowadays, routine aurora imaging observations with high time resolution are conducted at many observation sites, and aurora imaging data have become widely available.

We are developing a technique for obtaining physical quantities from aurora image data. In our technique, the variations of an aurora are decomposed into a persistent component (no blink) and residual fluctuations. The persistent component shows drift motion, which is possibly associated with the large-scale magnetospheric electric field. The residual fluctuations are related with the pulsating aurorae, which would be related with magnetospheric plasma waves. The persistent component and the flow pattern of its drift motion can be extracted by using an approximation of the Kalman filter algorithm. Since each auroral image which consists of a large number of pixels is high-dimensional data, it requires high computational cost to apply the standard Kalman filter algorithm. In order to reduce the computational cost, we represent the drift velocity distribution on an image by a stream function expanded using 36 basis functions. In addition, each uncertainty covariance matrix is approximated by a diagonal matrix. These approximations enable us to obtain an efficient algorithm for estimating the persistent component and the flow pattern. We will describe the outline of the proposed method and demonstrate some results.