

Stereo measurement of auroral emission altitudes using circular fisheye digital cameras

Kai Shigematsu^{1*}, Yoshizumi Miyoshi¹, Ryuho Kataoka², Masayuki Tanaka², Atsushi Yamashita³, Yoshiki Mori⁴, Takayuki Kubo³, Don Hampton⁵, Tatsuki Ogino¹

¹STEL, Nagoya University, ²Tokyo Tech, ³University of Tokyo, ⁴Shizuoka University, ⁵University of Alaska

The 3D structures of aurora tell us important information on the energy of precipitating electrons as well as the mechanisms. The purpose of this study is to estimate the emission altitude of aurora using pictures by digital cameras. It is fundamental to pursuing the altitudes and morphology of aurora in detail using new imaging instruments to advance our understanding of the generation mechanism of the aurora. We have been challenging a stereo imaging of aurora since 2009 using digital cameras equipped with fish-eye lens in Alaska. We installed two digital cameras for the time lapse observations with 3-60 s intervals; one is installed at the Poker Flat Research Range (PFRR) of University of Alaska, Fairbanks and the other is installed near the PFRR. For three winter seasons, we conducted a variety of experiments with different separation distance (3-8 km) and with a different set of cameras using Nikon D90, D7000, D3s, D3x, and D4. There are several advantages of digital cameras against to usual CCD observations such as high spatial resolution, full-color observations, and low-cost operations. A number of images more than 3 TB have been obtained for three seasons. In order to estimate the emission altitudes, we firstly estimate the camera parameters to calibrate the fish-eye images into absolute coordinate using the star positions [Mori et al., 2012]. We then apply plane sweep method to find the altitudes of maximum correlation of two images changing the mapping altitude and estimate the possible altitudes of aurora. We estimated the possible auroral altitudes for 13 examples, and the altitudes are distribute in 110-160km.

Keywords: auroral altitude, plane sweep, stereo fisheye digital cameras