

Automated detection system of aurora using deep learning: real-time operation in Tromsø, Norway

*Sota Nanjo¹, Keisuke Hosokawa¹, Satonori Nozawa²

1. The University of Electro-Communications, 2. Nagoya University

With the increase of the ability of computers, we can use the deep learning technique easily for various tasks. Such a technique has also been applied to the auroral physics in recent years. Most of optical observations of aurora store all the data overnight regardless of the appearance of aurora. Consequently, the obtained data contain a massive amount of non-auroral data which are basically useless for auroral physics. Classification of these data is important especially for the statistical analysis of aurora. Clausen and Nichisch (2018) classified the optical data taken from Time History of Events and Macroscale Interactions During Substorms (THEMIS) All-Sky Imager (ASI), the ASI network over North America, using the deep neural network technique. They classified optical images into 7 classes: arc, discrete, diffuse, cloudy, moon, and clear. Their result showed that the classifier has an accuracy of 82% for the validation data. The optical images from THEMIS ASI have no color information (i.e., panchromatic); thus, the result may change if we use optical observations performed by the digital single-lens reflex cameras having three color channels. Kvammen et al. (2020) classified the digital-auroral images into 7 classes. They used the model of ResNet-50 (He et al., 2016) and the result had a precision of 92%; however, their classifier does not cover the non-auroral images. For this reason, we are still not able to analyze a massive number of digital images including the non-auroral images (for example, cloudy, moony conditions) statistically. In this study, therefore, we created a classifier, which can handle all digital camera images including the non-auroral images, using ResNet-50. The classes are arc, discrete, diffuse, aurora+moon, aurora+cloud, clear, cloudy, and dusk/dawn. The training result has a precision of 92%. We published the training data and analysis results on the website. The website also notifies the appearance of aurora in real-time. In the presentation, we will introduce how to use the website and the results of the statistical analysis for the 10 seasons from 2009 to 2020.

Keywords: Machine Learning, Aurora, Digital camera observation, Statistical analysis