Automatic Classification of Auroral images using optical flow feature

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The machine learning technique including the deep learning has been developed and the practical uses have increased on various field. On the study of auroral detection, the concern over the automatic image classification has risen using the approach of machine learning technique for the large statistical analysis of auroral images. The automatic auroral image classification has tried to use some techniques from computer vision, machine vision and pattern recognition. There are roughly two kinds of the selected feature: the color of image and the motion of aurora image sequences. The works based on the color feature of aurora image have been performed by Rao et al. (2014) and Tanaka et al. (2015). Rao et al. (2014) performed Support Vector Machines (SVM) classification with several local feature extraction techniques, and found that Scale Invariant Feature Transform (SIFT), OpponentSIFT, is the most effective feature for the automated classification of color aurora images. Tanaka et al. (2015) used the aurora area using the HSV model. They mentioned that it is difficult to classify the images including the diffuse aurora and cloud area. The color feature work well for the color auroral image, while the gray-scale (optically filtered) auroral images need other features on the automated classification. Blixt et al. (2006) applied the optical flow estimation to auroral image sequences. Their case study showed the useful tool for representing the motion of the aurora. In this study, we validate the optical flow estimation to extract the feature of auroral image, and automatically classify the large gray-scale auroral images using the machine learning with Convolution Neural Network (CNN). We use 63,486 gray-scale aurora images in total and use five categories for the preparation of supervised learning data, 1) aurora, 2) aurora and cloudy, 3) aurora and moon, 4) aurora, cloudy and moon, 5) noaurora. We perform the Hold-out and the Cross Validation to evaluate our classification performance. We obtained 98.58% of the classification accuracy based on Hold-out and 98.47% of the classification accuracy based on Cross Validation.

Keywords: Aurora, Optical flow, Convolution Neural Network

