Automatic Aurora Recognition based on HSL colour ranges

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Abstract

We develop a real-time capable method for automatically recognising auroras in all-sky camera (ASC) colour images. A fast image recognition algorithm allows to build a nowcast service based on ASC data with a higher accuracy compared to nowcasts based on geomagnetic proxies. We classify all pixels in an image based on their HSL (Hue-Saturation-Lightness) values into two groups: aurora and no-aurora. Furthermore, we find a global threshold value that defines the minimum number of aurora pixels required to assign the image to the aurora category. In the presentation we describe the details of our classification method and present some preliminary results from its validation.

1. INTRODUCTION

Automated digital cameras equipped with fish-eye lenses are operated at auroral latitudes by several research institutes both for scientific purposes and to support auroral tourism. On the Northern hemisphere imaging season extends typically from September to April. During such a season a camera taking images with a 10 sec cadence produces easily more than 600 000 images. Auroras appear only in a fraction of those images and pruning them out from the massive data archive for further analysis is a challenge which requires automatic categorisation routines. Promising results have been achieved with machine vision approaches that recognize auroral structures from all-sky camera images (Syrjasuo and Partamies, 2012; Rao et al., 2014). These routines are accurate but require careful training of the routines by an experienced scientist.

We present an alternative approach for ASC data pruning, which as a simple and transparent solution is suitable for near-real-time services supporting auroral tourism. The proposed approach analyses individual pixels in colour images. Besides binning the pixels into the two main groups (aurora and no-aurora) our goal is to characterise automatically also the background conditions (clouds, clear sky, moon).

2. THE ALGORITHM

The pixel categorisation is based on HSL values. We define minimum and maximum values for H, S and L and apply those as a threshold to each pixel in an image. If the H, S and L values of the pixel are within the HSL ranges, the pixel is classified as aurora. If one or more values are outside of the HSL ranges, the pixel is classified as no-aurora (Fig. 1).

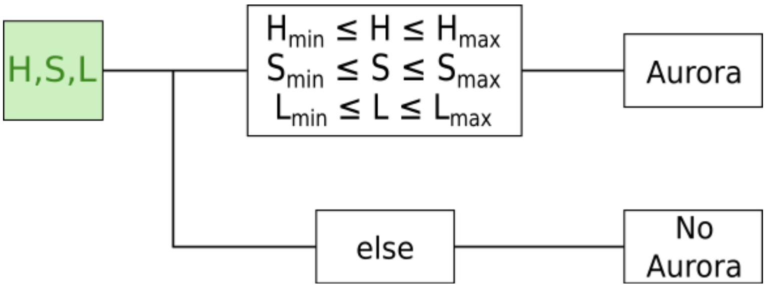

Figure 1: Schematic presentation of the pixel categorisation

ASC data is stored in AVI format. We extract individual frames from the video at a resolution of 1 frame per minute. The frame is transformed from RGB (red-green-blue) colour space to HSL colour space and a mask is applied to the image to cut away trees and other objects at the horizon. The image is cropped to the size of the mask to reduce the number of pixels that are processed. Each pixel is assigned to a category (Figure 2) and subsequently a global threshold is applied to the number of aurora pixels. If the number of aurora pixels is greater than or equal to 10% of the total number of pixels, the image is classified as aurora. Otherwise the image is categorised as no-aurora.

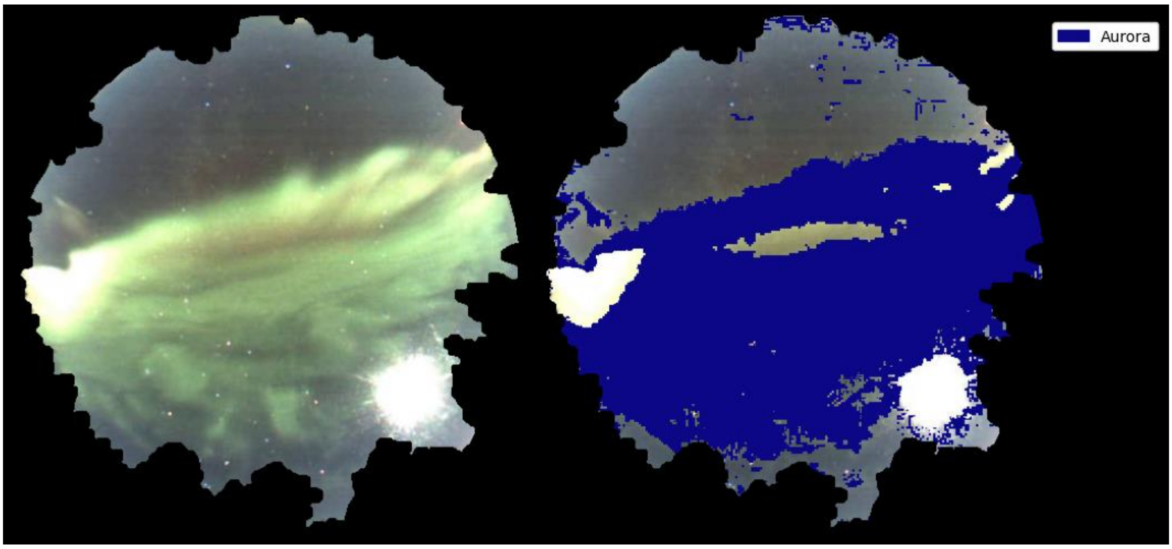

Figure 2: Masked and cropped All-sky camera image on the left. Pixel categorisation on the right. Aurora pixels are marked in blue.

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