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Multiresolution Analysis and Machine Learning Methods for the Classification of Auroral Images

The Aurora Borealis (or Northern Lights) is a natural phenomena regularly observed in North America which has fascinated humans for thousands of years. Even today, this phenomena gains a great deal of attention from the general public, media outlets, tourists, and scientists, where the latter have been collecting data on auroral behaviour for many years, most notably in the form of *all-sky images* (ASI). In recent years, there has been a push to label ASI data with the specific classifications that an aurora can take, e.g. arc, diffuse, discrete, etc..., which gives rise to a particularly interesting interdisciplinary *image classification problem* that many believe would greatly benefit from the usefulness of *machine learning* (ML). For our purposes, we intend to use this classification problem as an avenue to highlight the compression possibilities that *wavelet transforms* offer in the preprocessing stage of ML by implementing a proposed *discrete projection algorithm* (DPA) that can calculate the coefficients of a particular wavelet basis efficiently and accurately. The resulting wavelet coefficients can then be used as input to a *convolution neural network* (CNN), which in our case will be trained and validated on the Oslo aurora THEMIS (OATH) dataset. We hypothesize that the combination of this DPA with even a simple CNN will result in classification accuracies $>$ 80% and have tangible improvements in the efficiency of the preprocessing stage.