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Investigating the concept of Fraunhofer lines as a potential method to detect corona in the wavelength region 338nm - 405nm during the day

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2015-04-28
http://hdl.handle.net/10539/17549

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ABSTRACT

It is essential to detect corona discharge as a symptom of insulation breakdown in high voltage applications. However the accuracy of such a measurement is often reduced due to the existence of solar background noise in the signal. Fraunhofer lines in the solar spectrum are areas of the solar spectrum where the solar radiation is lower in intensity due to certain wavelengths of light been absorbed by gases in the sun. Analysing the corona and solar spectra reveals that there exists an overlap at certain wavelengths between corona peaks and Fraunhofer lines specifically between the 300nm - 400 nm wavelength range. This thesis will explore the potential of evaluating corona activity at these Fraunhofer lines and through signal processing optimise the signal to noise ratio. One of the signal processing techniques used was the implementation of an optical band-pass filter. From the results obtained it was determined that the purchased optical filter was not filtering out the solar radiation and hence no corona was detected. The signal to noise ratio was 0.0314. Consequently it was decided that the optical filter specifications (i.e. (FWHM) and central wavelength (CWL)) were not ideal. Hence a new approach of simulating an optical narrow band-pass filter in MATLAB was applied. The MATLAB model allowed the filter to adjust its bandwidth along the wavelength range until the highest signal to noise ratio was obtained. The signal to noise ratio was 2.121. The simulated filter specifications that generated the highest signal to noise ratio had a FWHM of 0.05nm and CWL of 357.558nm which coincided with the wavelength of a different Fraunhofer line and a different corona peak. The results verified that with the newly designed filter the signal to noise ratio increased by 67%. Thereafter cross correlation was performed for extracting the corona signal from the solar background noise. Correlation proved to be an efficient technique to detect corona in the presence of solar radiation. In essence Fraunhofer lines can be used to detect corona activity during the daytime with the implementation of a suitable filter as well as through cross correlation.