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Geoscientific Instrumentation Methods and Data Systems
Discussions

Interactive comment on "Auroral spectral estimation with wide-band color mosaic CCDs" *by* B. J. Jackel et al.

Anonymous Referee #1

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General Comments

This manuscript is an evaluation of different techniques whereby color mosaic charge coupled device (CCD) detectors are applied to quantitative spectral measurements of upper atmospheric emissions (e.g. aurora) in the form of two-dimensional images. The effective spectral resolution of two commercially available CCDs is evaluated via Backus-Gilbert inversion techniques, as is the resolution of multiple combinations of such CCDs and additional filters.

In the introduction, the paper describes the basics of the auroral emissions commonly observed, commercial evolution of increasingly lower cost CCD technology and some scientific applications, and current panchromatic and color mosaic imaging systems

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Discussion Paper

currently deployed. This is followed by a concise description of color CCD technology for the two CCDs considered. The spectral estimation section follows, where the Backus-Gilbert inversion technique is presented in a manner easy to follow for the non-specialist. The discussion section contains practical information regarding the combination of two or more detectors (with or without additional filtering), and the resulting improvement on spectral resolution.

The manuscript presents interesting and novel techniques to applications of existing commercially-available low-cost imaging systems, and in a quantitative manner. The implications of quantitative spectrophotographic measurements at low cost and a high degree of deployability have the potential for significant scientific advances in auroral and upper atmospheric research.

The paper is well organized and clearly written in precise language. The scope of the research is appropriate for the forum. The figures and tables are clear, consistently labeled, and have appropriately descriptive captions. There are only some minor scientific and technical issues. Once those are addressed, I will recommend the manuscript for publication in Geoscientific Instrumentation, Methods and Data Systems.

Specific Comments

Line and page numbers correspond to file: gi-2013-26-discussions-typeset_manuscript-version2.pdf

Abstract: Many times throughout the paper, an emphasis on the necessity of simultaneous multispectral observations is reiterated. This is owing to the need to accurately image highly dynamic aurora. Since this need is one of the primary motivators for undertaking this research, I feel that the need for simultaneous spectral information should be indicated, albeit concisely, in the abstract.

What is more, is it possible to cite some specific examples in the introduction of what spatio-temporal resolution is required for some selected auroral types (e.g. substorm

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onset, pulsating aurora, flaming aurora, etc.)? For the non-expert, it would be illustrative to contrast these with auroral types that evolve more slowly (e.g. cusp polar moving auroral forms, theta aurora). As to not go beyond the scope of the paper, a couple or three sentences at most should suffice.

Finally, I noted that there is no paragraph in the introduction that outlines the remainder of the paper. While it is not absolutely necessary to have one, it is commonly done in peer-reviewed manuscripts in space physics and aeronomy.

P. 4, Line 2: "This drastically reduces total photon flux reaching the detector, requiring the use of expensive image intensifier or electron multiplier technology to achieve acceptable levels of signal-to-noise (SNR) even with longer integration times." Does this assume highly dynamic (e.g. nightside) aurora? I don't believe the requirement to use intensifiers or electron multiplication is strictly true for all types of aurora. If the authors' intent was to qualify this statement for a particular type of aurora (i.e. highly dynamic aurora), please indicate that. Alternatively, the scope of the paper can be narrowed to the subject of highly dynamic aurora in the abstract and introduction, as mentioned above.

P. 8, Lines 5-17: It is odd that the descriptions of the Icelandic Rainbow imagers are very detailed (down to the diameter of the dome), while only one sentence states the existence of a Rainbow at Kangerlussuaq. Perhaps the descriptions should be a little more balanced?

P. 12, Line 20: "One goal of this paper is to better under-stand how this loss of information impacts spectral resolution." Is this addressed explicitly later in the paper?

P. 31, Line 26: "The first set of requirements are essentially identical to those for a single imager i.e. heated building with observing dome, electrical power, and network link." A network link is not essential for obtaining auroral images. Thermoelectrically-cooled CCDs generate their own waste heat that, for example, can be contained in a small, well-insulated enclosure. The only thing mentioned that is really a requirement

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is electricity. If the description above is only one example, shouldn't the abbreviation 'e.g.' be used instead of 'i.e.'?

Technical Comments and Suggested Corrections

P. 3, Line 11: does background need to be in quotes? Is it only to differentiate it from the use of background in Line 12?

Please be consistent in the use of double quotes: P. 3, Line 21: all-sky has no quotes, while it does on p. 15, Line 1

* Also, it is a matter of style, but I believe the following do not require double quotes: hot mirror fish-eye (a dictionary lookup shows that fisheye is also acceptable) filter wheel all-sky

* infrared is an acceptable simplification of infra-red

* panchromatic is an acceptable substitute for "white-light" or white-light

P. 5, Line 4: Partamies et al. ... This sentence has tense disagreement. The verb in the first clause (presented) is past tense, while the verbs in the next clauses (provide, apply), are in present tense.

P. 8, Line 9: "University if Leicester" should be "University of Leicester"

P. 18, Line 1: "linear inversion or retrieval or estimation" Should this be "linear inversion, retrieval or estimation"?

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 3, 753, 2013.