Geosci. Instrum. Method. Data Syst. Discuss.,
https://doi.org/10.5194/gi-2019-20-AC1, 2020

Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Semi-automated roadside image data collection" *by* Neal Pilger et al.

Neal Pilger et al.

npilger@uoguelph.ca

Received and published: 12 February 2020

Anonymous Referee #1 Received and published: 26 August 2019

RC: This article reports on a system to acquire ground reference data on crop fields from a car mounted side-looking set of cameras. The work is interesting and seems to focus on an operational application of governmental/environmental agencies. The paper is clear, easy to read and focused on a real-world problem. There are, however, a set of concerns:

RC: A fuller discussion on training and testing data acquisition is needed in the introduction. In some instances a small number of geo-referenced photos may be adequate but this is far from a complete discussion. Issues of sampling (notably the sample size

and design) and basic data collection (the spatial grain) etc. need fuller discussion.

AC: The goal of this study was to provide a census, not a sample. Every field was imaged, so the sample size was 100% (less those fields that were obscured by trees or hedges - and those numbers are few -less than 1% of the area fields). This point will be clarified in the introduction and again in the methods section.

RC: Sample design is a key issue that needs fuller discussion in the article as the approach used is not a probability sample. As such it may meet many needs but not all (e.g. as noted below it would be an unsuitable sample to use in image classification accuracy assessment).

AC: This study was an area wide (county level) census, not a sample. In follow up studies we are separating the fields imaged randomly and using 50% for calibration and 50% for validation. This study was focused as a technical letter for a description of an efficient and cost effective process for collecting ground reference data (1 person vs 30; 5000 fields vs 50, one vehicle vs six, 5 hours vs 12, etc.). As with the previous comment, this will be further clarified in both the introduction, and in the discussion portion of the paper.

RC: The description of the test site must make it clear that CS sites are also present - this class is not mentioned yet its presence is critical to the study.

AC: Conservation (CS) tillage sites are mentioned in the paper, combined with No-tillage sites, they make up roughly 60% of the harvested fields surveyed. I do see the confusion here, to remedy this we will include a Totals table with both number of fields in each class as well as overall percentages. Thanks.

RC: In the data processing the discussion is very vague. It would be really useful, for example, to know how many photographs were retained and used.

AC: These values were included along with the new table as described in response to your previous comment.

RC: The data processing section needs to address aspects of privacy (which do get mentioned late on the paper on p12). The system really needs to be able to acquire data in a way such that faces and items such as car licence plates are blurred out. This type of processing is quite basic in systems that seek to ensure GDPR compliance.

AC: I agree, that from a commercial standpoint this would be useful - the blurring in Google Car imagery, however, is performed post data collection using recognition (AI) software. As this was a pilot research project (not designed for commercial dissemination), instances where houses, people or vehicles were imaged were simply discarded. The rate of image capture was such that 2-3 images would be captured of every property. We were not interested in house, only post harvest agricultural fields. Therefore, the only images that were of other vehicles or people, were captured at intersections, or when passing through residential and/or commercial areas on the outskirts of the agricultural area - these images were of no use to the study, so were deleted during primary sorting following data capture.

RC: More details on the labelling of photographs is required. Were photographs labelled by just a single person? In many studies labelling is often based on 3+ annotators – allowing basic consensus approaches to be used as well as flagging uncertain cases.

AC: Post sorting and deletion of non-agricultural field imagery, all subsequent images were visually classified by 4 individuals and recorded on spreadsheets. Contrary classifications were allocated their final classification based on simply majority. For the 4 classes, confusion was primarily between Conservation (CS), and No-Till (NT) classes where quantification of residue was close to 60% (the division between the two classes). Cover crops were green, and Conventional tillage was lacking any significant residue, therefore mis-classification of these categories was virtually non-existent. The confusion between Conservation and No-Till, was also slight, and considered acceptable, as both are actually conservation tillage methods. Further clarification on this matter should have been included, and was addressed in the subsequent draft.

RC: The authors deem their results to be acceptable. They may well be but it should be based on strong evidence and reasoning. What level of error is tolerable? The authors also need to recognize that the accuracy of the system will vary with relative abundance of the classes, accuracies in the order 80-100% seem quite feasible. Is the lower value stlll acceptable?

AC: As addressed in response to the previous comment, error was deemed acceptable as it dealt with confusion between upper levels of tillage in Conservation classes (30-60% residue) and No-Tillage (60% + residue) classes. Both represent conservation tillage, with very similar end results. This was clarified again in the conclusions.

RC: The work in many ways is an automated version of a basic windshield survey that has been used for decades. Why not compare to a windshield survey – a qualified individual sitting as a passenger in a car would probably be very accurate.

AC: The rationale behind not employing a standard windshield survey is in human error, missed fields, reduction is vehicle speed to permit GPS and class recording, and inability to simultaneously record information from both sides of the roadway. Another key benefit is the production of hard data which may be re-examined at a later date, or employed in change detection studies. Finally, having one or (better) two passengers recording information requires additional personnel, which increases data collection costs. This study was based on securing the greatest amount of data in the most efficient and cost effective manner, hence a single driver, and multiple cameras automatically capturing imagery at 3-5 second intervals.

RC: There are a variety of obvious issues that are not addressed well. These range from clear concerns such as the presence of hedges/fences that obscure view to problems of inter-cropping. These probably do not crop up much in the test site but deserve mention.

AC: The issue of intercropping was not an issue for the fields imaged by the roadside survey vehicle, however, we agree that some mention should be made for this case. For the counties chosen for post-tillage residue assessment, fields are planted in annual rotations (for the most part), consisting of corn, soybean, or winter wheat. As for concerns relating to features obscuring camera view, these were images were discarded dduring initial sorting/classification along with non-agricultural field images, although the roadside vehicle does carry a pair of UAV's, so realistically those obscured fields could be imaged, if it were not for concerns discussed in response to your comment regarding UAV systems below. The cameras were automated to capture an image at set temporal increments (e.g. every 5 seconds), so along with duplication from when the vehicle was at a stop, such images were extracted from further classification. We suspect overall we conducted a 99% census of post harvest tillage residue in the region of study. Further clarification on the number of images removed during initial sorting will be included in the subsequent draft.

RC: A potential problem with the work is the reader making an innocent mistake and thinking the system would be useful as a source of testing data for validating/accuracy assessment of satellite image classifications. This system is not (and the authors do not claim it to be). It should still be recognised that good practices for validation call for a probabilistic sample – the sample acquired by the system does not meet this – it is biased (to roadside locations) and unrepresentative. This issue should perhaps be noted simply to stop an interested reader making a mistake.

AC: We have included a comment to this effect. However we also argue that this study serves as a potential surrogate to traditional ground reference data collection which is costly, inefficient, potentially dangerous, and involves property trespass. Relative to our ground survey data our the classification of the vehicle mounted images provides acceptable classification accuracy. Further the data collected by this roadside survey method captures every field in the study region (given the structure of fields and roads in this region).

RC: I cannot help wonder – why use this system and not a basic, nadir viewing, photographs from a drone/UAV? Cheap, easy to use from roads etc. and is nadir view that

fits with the standard ground data. Surely a UAV based camera system offers a better outcome?

AC: Yes, a UAV would be more versatile with the ability capture both oblique and Nadir image data, in RGB or False Colour format. The vehicle used in this project actually carries two UAVs in the back. The main issue with running them as opposed to the roadside survey as performed lies in the limited range, and time requirements to operate drones within the legal requirements put forth by Transport Canada. Excepting extreme circumstances (e.g. search and rescue operations) Drones in Canada must be down line-of-sight (LOS) only. Additionally there are restrictions barring operation without Special Flight Operations Certification (SFOC) within 100 metres of any person, vehicle, occupied structure, and livestock. Barring such legal restrictions, a stop-and-go survey of every field at a county-level scale would be no more efficient than physical trespass into the fields as is the current method for generating a sample of tillage practices. This study was designed not to sample, but to provide a large area census with minimal costs, and personal. The reason why the vehicle does carry UAVs, was to address one of your previous concerns regarding the obstruction of clear lines of sight from hedges/fences which, while not numerous are still prevalent in the study areas we were looking at. However, to facilitate maximum coverage in minimal time, such obscured field images were removed during the preliminary sorting/classification phase. Mention of this issue was implemented in the subsequent draft.

RC: Minor issues: - The term 'corroboration data' is unclear – perhaps use 'ground reference data'? -

AC: Agreed. This has been updated as suggested

RC: Clarify the last sentence of the introduction – what is the role of the orbital data? -

AC: Removed 'orbital data' which referred to unsupervised classification of Landsat imagery; and replaced with: "The survey system was developed to compare to in-field photos for measuring soil cover in order to determine the value of roadside acquisition for both routine ground truth data collection for remote sensing analysis of soil cover, and the utility of using such data collection as a surrogate to standard practices which are both costly and inefficient to implement".

RC: It is awkward to refer to 'RS' in Table 2. On superficial reading this might be interpreted as meaning remotely sensed (e.g. from satellite). Need to be clear this is from the car-based camera system.

AC: We agree, this acronym was altered to avoid mis-interpretation.

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2019-20, 2019.