Additional Information on Pre-/post-flight Calibration Targets

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Buying a pre-/post-flight calibration target is a big investment, but good targets are essential for comparison between flights, across sites and with other sources of reflectance measurements (such as satellites). We hope that this additional material proves to be a helpful guide in the process of purchasing or loaning a target.

This document is the result of two years of trial and error collecting multispectral imagery with drones in the Canadian Arctic and has been informed by many conversations with the experts at the UK NERC Field Spectroscopy Facility (we are particularly in debt to Chris MacLellan). However, it is by no means exhaustive and we are still at the early stages of developing best practises. Please get in touch if you have any questions, comments and suggestions.

Content

Target reflectance value

Surface reflectance values for vegetation lie on average between 40-60%. Ideally, a calibration target would match the surface of interest as best as possible. In practice, a target close to this range should be sufficient.

Spectralon and similar targets are available off-the-shelf at set reflectance values, such as 50% and 75%. Customised targets with other reflectance values are also available.

The response of a multispectral sensor is likely to be linear in most of its range (enquiry for Parrot Sequoia pending) and the error of the radiometric calibration in the software (e.g. Pix4D mapper) can be expected to be symmetrical around the reflectance value of the surveyed surface (Pix4D Support, personal communication, May 2017). Hence, going a bit above or below should not make any difference.

Panels with lower reflectance values are less likely to overexpose in the calibration imagery and small amounts of contamination will have proportionally less of an impact on their reflectance value compared to whiter targets (NERC Field Spectroscopy Facility, personal communication April 2017).

For practical reasons, we would therefore recommend a 50% target for pre-/post-flight calibration; advice also shared by Pix4D (Pix4D Support, personal communication, May 2017).

Size and weight

In theory, the larger the statistical sample of pixels (and hence the size of the target), the better the calibration. However, the larger the target, the bulkier and heavier it becomes. For Arctic fieldwork going bigger might not always be better. Finding a healthy optimum is therefore important.

Currently, we are not aware of any tests that have been conducted to identify minimum / optimum target sizes.

We recommend something between 15 x 15 cm (6" x 6") and 20 x 20 cm (8" x 8"), but smaller 12.5 x 12.5 cm (5" x 5") or larger 25 x 25 cm (10" x 10") targets should work as well.

The standard, pure Spectralon targets can be quite heavy, particularly the 10" x 10" version. Zenith Lite Targets (or alike) can be a more practical alternative (available in 50% reflectance and 20 x 20 cm).

Casing, protection and tripod use

To facilitate protection and easy handling of the targets a good container is needed. We suggest using a hard-case container that will protect the target from physical damage and from the elements. Some options are available also with removable lids and tripod mount attachments.

Spectra Vista Corporation (UAS) produces light-weight wooden cases (with tripod attachment) that seem to be a good option (recommended by NERC FSF, personal communication May 2017).

The NERC FSF, recommends the use of tripods to elevate the target above ground, allow for optimal levelling (using a spirit level), reduction of shadows and protecting the target from dirt etc.

Loaning/sharing targets

Good quality targets are expensive and purchasing them might not always be an option. It might be worthwhile considering loaning a target from someone in your institution (most people doing field spectroscopy are likely to have one) or buying a target shared with someone.

In the UK, NERC funded research projects might be eligible for support from the NERC Field Spectroscopy Facility, from which various targets and calibration panels can be loaned.

Redundancy and Degradation

For long field seasons, it can be good to have multiple targets for redundancy. Plus, it might allow you to measure target degradation. The latter could be done with a stable tungsten halogen light source (or the sun at noon) and your multispectral sensor or a field spectroradiometer (if available). A 'safe' standard panel that is kept at your base station could be helpful for this.

For the field season 2017, we are planning on taking two 50% 20 x 20 cm Zenith Lite targets for in-field operations and a 75% 25 x 25 cm Spectralon target as a 'safe' standard. We are planning to use or Sequoia sensors to obtain a 'calibration' picture showing all panels simultaneously at regular intervals (weekly). This will be done at the base station, in a dark room using a tungsten halogen light source at a set angle to the targets. This might also allow us to assess sensor degradation - assuming no degradation of the 'safe' standard.

Final note on pre-/post-flight calibration

At the moment, little information is available on the quality and error of ground-based pre-/post-flight calibration with reference panels.

Standing next to the target and holding the drone above it, is likely to change the irradiation hitting the target even if no shadows are cast on it. Beware of wearing highly reflective clothing, particularly red colors. It is difficult to say whether or not the resulting error is within the accuracy of data collected with drone-based multispectral sensors.

Also, there have been a few questions about the Sequoia's pre-flight radiometric calibration process. The automated calibration photos the Sequoia captures a set of photos bracketed to different exposures. This ensures that one of them is most likely accurately exposed even if the auto-exposure setting is influenced by background colors (i.e. dark grass contrasting with the white exposure plate). When taking radiometric calibration photos with other sensors, be mindful of this potential hazard, i.e. make sure you are not overexposing your photos during calibration as that means data will be lost.

In the long run, in-flight calibration with large high-quality targets could prove to be the most reliable way of calibrating multispectral drone imagery. However, for this, affordable, practical and reliable in-flight targets need to be developed and then data collected to compare the two methods of calibration.

Useful Links (not exhaustive):

Labsphere, USA (Spectralon Targets)
Sphereoptics, Germany (Zentih Light Targets)
Spectra Vista Corporation, USA (Target cases)
NERC Field Spectroscopy Facility, UK (Target loans and support for UK NERC funded grants)