Thermal Infrared remote sensing with a FLIR Vue Pro-R

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Abstract:
The FLIR Vue Pro-R (FVP-R) is marketed as a radiometrically corrected thermal camera specifically designed for small UAS. The manufacturers claim that the FVP-R records accurate, calibrated temperature data, rather than uncalibrated DN values found on other thermal sensors. Uncooled microbolometer sensors also suffer from instability when the camera body temperature changes [1]. It is important to discover how prone the FVP-R is to this problem.
Before using the FVP-R in a fully operational sense it is necessary to validate the performance of the sensor. It is also essential to determine the best format in which to collect the data, to understand the effect various settings available, and to develop an efficient workflow to pre-process the images into a format that is ready to be processed into an orthomosaic.
Initially a series of bench tests were carried out with a blackbody to provide a steady source temperature. The tests recorded the calibrated temperature as reported by the FVP-R, the measured temperature of the blackbody, and the body temperature of the camera. Comparison of the changes in these temperatures showed that the FVP-R was indeed able to compensate for changes in the camera's body temperature, so long as the rate of change was not too fast. When first turned on from cold the camera body temperature changes quickly and this has an effect on the accuracy of the measured temperatures. Thus it is sensible to turn on the camera well before intended acquisition to allow body temperature to stabilise. However, it needs to be tested how stable the camera body temperature is in flight whilst it is subject to varying winds that will cool the sensor a varying rates.
The FVP-R also does not come with software to convert all collected images in bulk to radiometrically corrected temperature values. Software provided will only allow the conversion of a single image at a time. The parameters required to convert the DN values to a calibrated temperature are stored in the camera Exif header. These values along with equations that allow for atmospheric transmission etc. are used to convert the DN values to temperature values for all images in the dataset.

Figure 1. Thermal Infrared map of exclusion paddock, Fowlers Gap.

References:

1. Berni, J.A.J., P.J. Zarco-Tejada, L. Suarez, and E. Fereres, *Thermal and Narrowband Multispectral Remote Sensing for Vegetation Monitoring From an Unmanned Aerial Vehicle.* IEEE Transactions on Geoscience and Remote Sensing, 2009. **47**(3): p. 722-738.