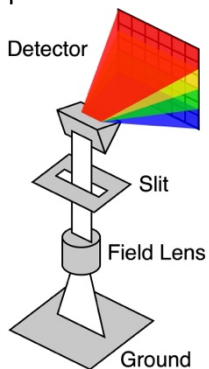


OpenHSI Information & Coating Data

The RoboNation OpenHSI is a push-broom imaging spectrometer that captures data in the VISIBLE-NEAR INFRARED (VIS-NIR) part of the spectrum with wavelengths between 430nm to 900nm. This type of sensor makes observations line by line and thus to make a 2D image (datacube) it is scanned along a target, much like a broom sweeping. Using the *OpenHSI python library* you can collect lines (swaths) and then construct them as an image or use the data line-by-line, or save it to file (a netCDF datacube).



The camera can be operated using a computer or microcomputer (that you supply) and supporting software to calibrate, capture, and process hyperspectral datacubes. The project was originally developed by staff and students at the University of Sydney. More are details available in the OpenHSI tech sheet and online materials.

Using the software, you can generate calibrated, nadir (looking straight down) radiances and surface reflectance by processing the data. Note – additional calibration data is required to obtain a reflectance, this may be an observation of an in-situ reflectance standard or from simulations using atmospheric data, such as 6SV. Once processed, this can be used to identify, with high statistical certainty, using techniques like spectral matching or machine learning.

For the Maritime RobotX Challenge, three coatings were developed to look the same (to the human eye) but have different spectral signatures. The OpenHSI data needs to be used to tell them apart. These are pictured in Figure 1.



Figure 1 - Coatings used in the Competition

We recommend you use NASA's 6SV (pyS6) radiative transfer corrections library, linked in the *OpenHSI software*, to generate your estimates of surface reflectance like those in Figure 2. This way, you adhere to Remote Sensing standards for dealing with the variation of light between observations. Once you have 'nadir surface reflectance', you can easily compare your OpenHSI's data against the lab spectra of the competition targets we have

Don't expect your spectral matches to be perfect! This OpenHSI data shows the spectral reflectance difference between each coating is significant (Figures 2 & 3).

prepared for you. These are taken looking straight down in the laboratory conditions. Figure 2 shows the reflectance of the three coatings taken with the OpenHSI sensor and generated using the *OpenHSI software*. Raw data will be provided in MS excel format.

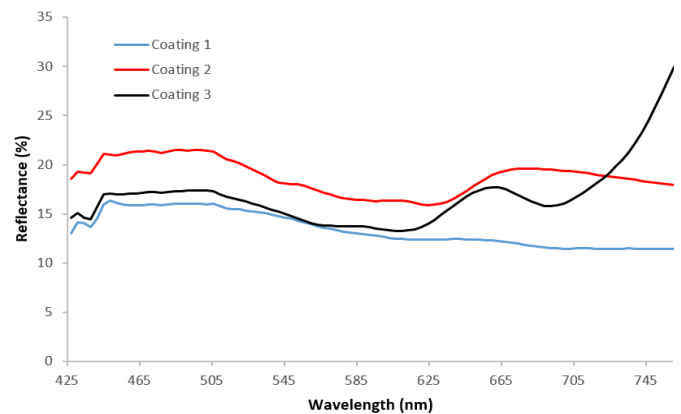


Figure 2 - Spectral Reflectance for RobotX Challenge Coatings

If you want to avoid converting to reflectance, you can use the calibrated radiances data, but you will also need to deal with how these vary with the light on the day in your spectral comparisons. This is possible and works in many cases, but it may not be easier. Figure 3 shows the radiances of the three coatings under lab conditions. Note the areas of variance between the curves is less pronounced than reflectance curves.

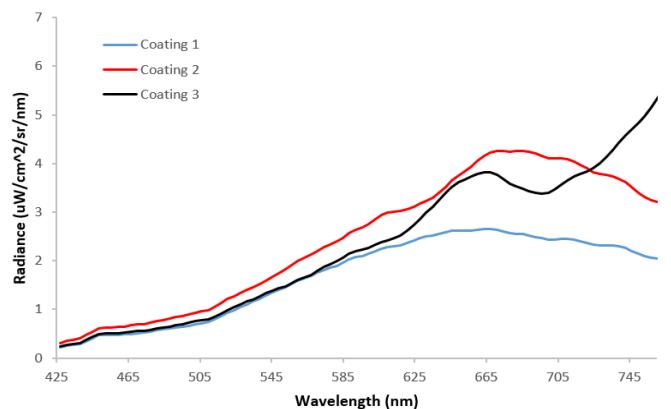


Figure 3 - Calibrated Radiance for RobotX Coatings

We recommend you connect your camera to a microcomputer of your choosing and port the software to capture, calibrate and perform your spectral matching tasks for the competition. The OpenHSI working group have used NVIDIA Jetsons, Raspberry PIs and laptops to do this via windows or Linux. Note - You do not necessarily have to have Py6S installed on the capture platform, but it may be more convenient. Enjoy and all the best, we look forward to your solution to this challenge!