unispectral

Quality assurance using hyperspectral imaging: **Leather classification**

Quality assurance is becoming increasingly important, particularly in supply chains where manufacturers, suppliers, and buyers all request to inspect goods and verify that they meet the required quality standards.

The identification of different materials is a crucial step in assessing the quality of a product. When this task cannot be accomplished by the human eye or RGB camera, image classification techniques are employed to detect and measure any differences from the quality standards.

To perform efficient quality assurance by sorting different materials, Unispectral offers its low-cost hyperspectral imaging technology.

Unispectral is an Israeli spin-off from Tel Aviv University that has developed a low-cost hyperspectral imaging technology using tunable filters. With its unique technology, Unispectral has set a new level of price-performance, making spectral imaging accessible and easy to integrate into different OEM systems such as inspection for quality assurance.

Sorting using NIR imaging system

Generally, when looking at different materials using NIR (near-infrared) cameras, differences in spectral signatures between the materials can be observed. For example, leather, cotton, and polyester each have distinct spectral characteristics, so when imaged in different wavelengths, each material reacts differently, absorbing and reflecting different amounts of light in each wavelength. By measuring these characteristics, classification becomes useful, and the sorting process is made easier.

Classification using Monarch - NIR multispectral camera

Unispectral's tunable multispectral camera is easy to operate, with a user-friendly application for data collection or SDK files provided in both C and Python. The camera provides 10 wavelengths in the NIR range between 680-940nm, from which the user can select. Physics shows that most materials have a smooth curve, with minor deviations between two close wavelengths. Accordingly, most applications require only 1-3 wavelengths for classification, while the 10 wavelengths provided with Monarch are usually used for the evaluation phase.

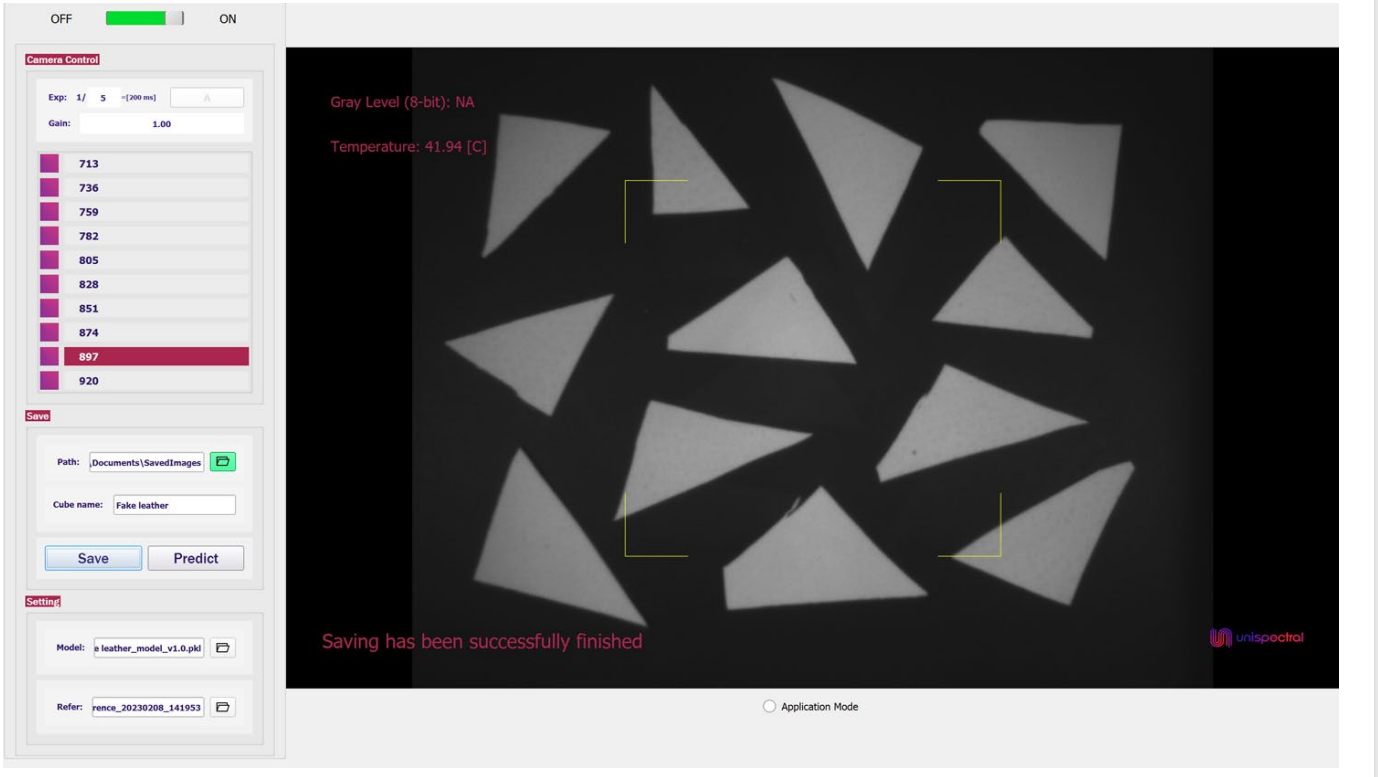
To classify, data must first be collected for the modeling phase, known as the training. This collected data will be used to create a reliable algorithm capable of classifying different materials. The principle is simple: the more data used for modeling, the more accurate the model will be.

1. First phase - Data collection:

At least one cube of each material is required for the modeling phase. It is highly recommended to use a Spectralon, which is a white reference material used for normalizing and compensating changes in environmental conditions such as light, temperature, and spatial variables.

First object - real leather:

Second object – fake leather:

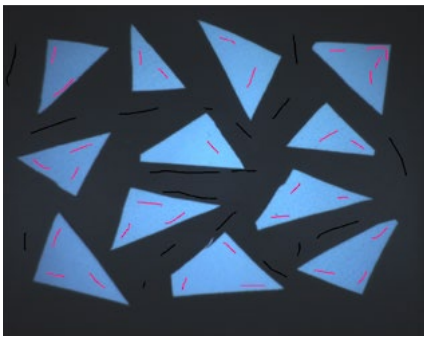


White reference:

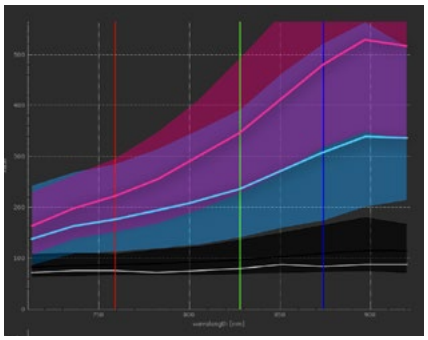
2. Second phase - Creating classification algorithm

The data collected in phase one is used to create a classification algorithm, where each object is labeled using the spectral signature of its material.

Real leather

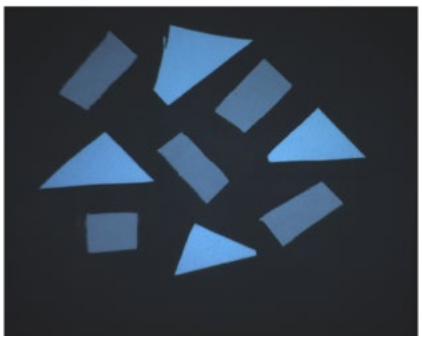


Fake leather

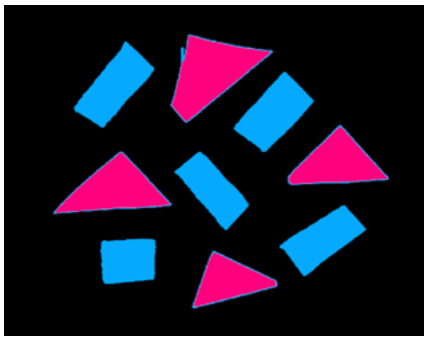


The spectrum (not normilized)

Mix Leather – Model Results:



Raw data



Model Decision

Confusion matrix

3. Third phase – applying the model performing classification

After applying the algorithm into the software, Monarch can successfully and reliably classify different materials based on their unique spectral signatures in the NIR range.

The Monarch multispectral camera is available both with and without a casing, as a PCB camera module. It is the smallest and most cost-effective solution on the market, making it the perfect option for any OEM application that requires classification in the NIR range.