
xiQ
MQ013MG-E2
SN: 237198173
STATUS 1
STATUS 2
POWER
Isolated I/O 5-24V 20mA max.
INPUT
OUTPUT
GND
USB 3.0 SuperSpeed
Based on the USB-IF's USB 3.0 specification.
For use with XIMEA approved connection cables only.
ximea
xiQ
USB 3.0
SuperSpeed
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Max Larin, XIMEA

HSI CAMERAS FOR FOOD SAFETY AND FRAUD DETECTION

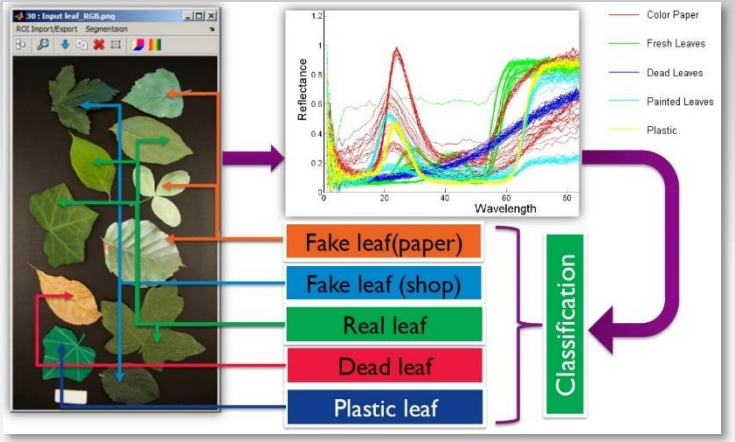
What are we talking about?

Food safety risks:

- Common for all countries, with some differences though
- 1/3 of population in developed countries is affected by food-borne diseases, more in developing countries
- (Almost) All diseases are preventable

Food safety risks breakdown

- Fraud and adulteration, probably most important in Russia
- Veterinary drug residues
- Fertilizer and growing aids
- Microbiological contamination
- Non-permitted food additives
- Pesticide residues
- Mycotoxins and other naturally occurring food toxicants



Challenge: Each material or substance characterized by unique spectra

Food safety analysis methods (post production)

- Microbiological analysis, destructive, long time, higher precision

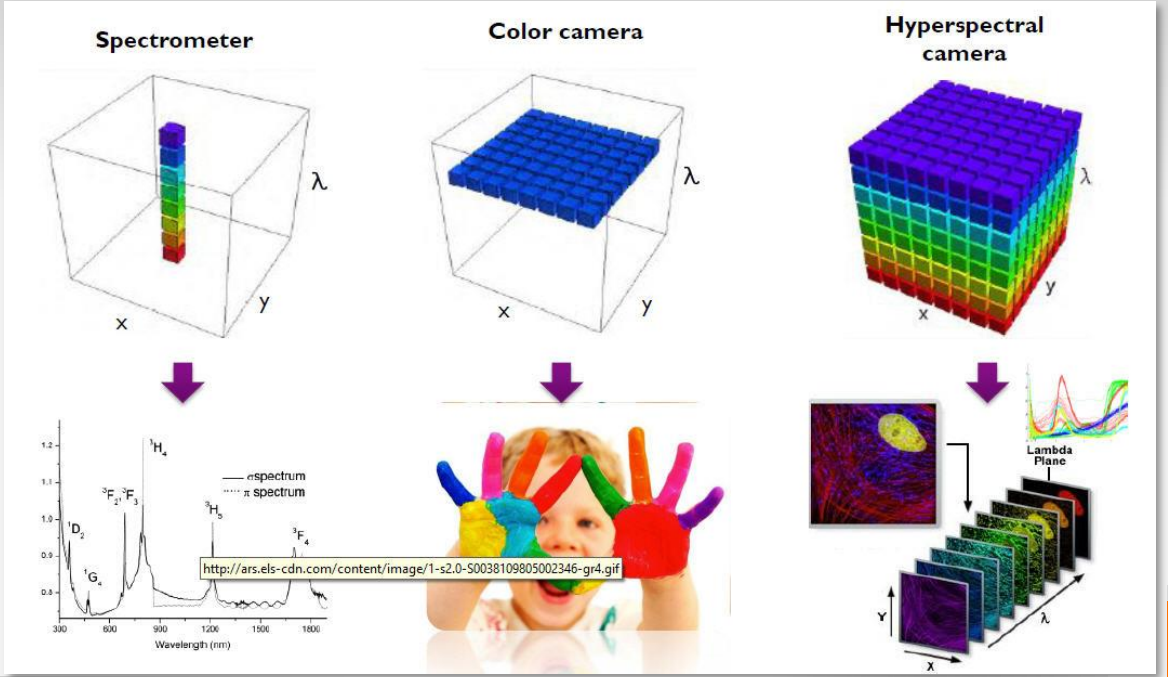
- Chemical analysis, destructive, long time, highest precision

- Spectral analysis, nondestructive, quick, medium precision

Spectral analysis technology

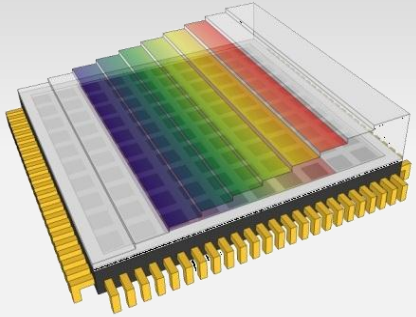
- Spectroscopy studies interaction between matter and electromagnetic radiation
- Spectroscopy, is usually meant as a single point measurement

✓ Spectral imaging is a combination of imaging and spectroscopy



Hyper Spectral Imaging

- Multiple methods, most are bulky and expensive
- HSI sensors from IMEC

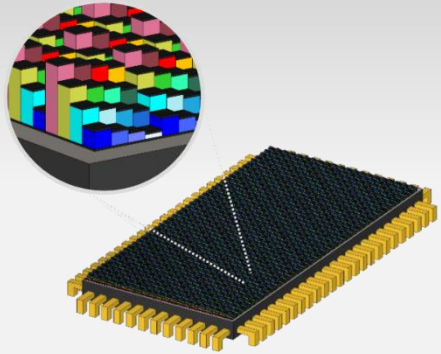


Linescan

'wedge' design

100 bands: ~ 600 – 975 nm

150 bands: ~ 470 – 900 nm (new)



Snapshot Mosaic

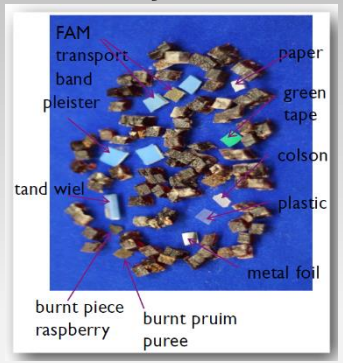
"per-pixel' design

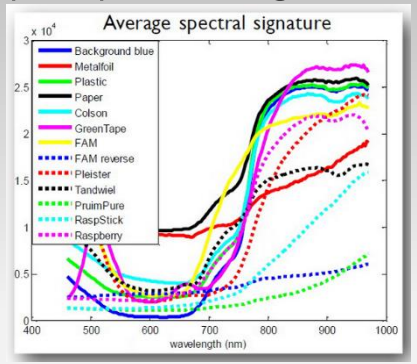
4x4: ~ 470 – 630 nm

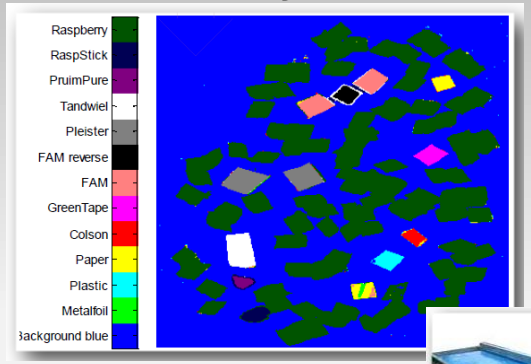
5x5: ~ 600 – 975 nm

Extraneous materials in food – HSI pipeline

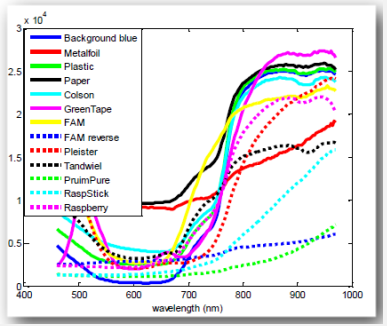
1) Each object has an unique spectral signature and can be correctly classified

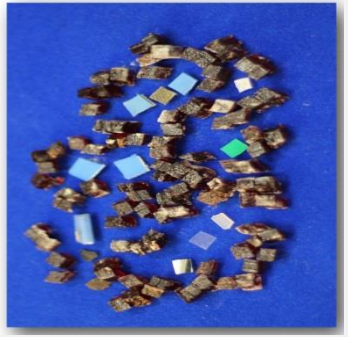


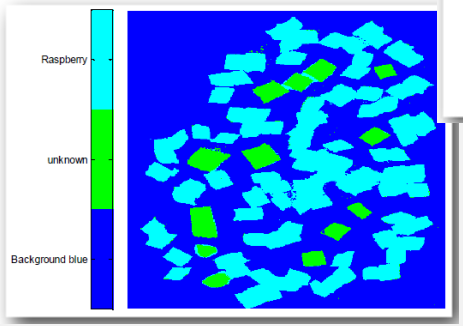




2) Detection of unknown materials based on the Library built from training



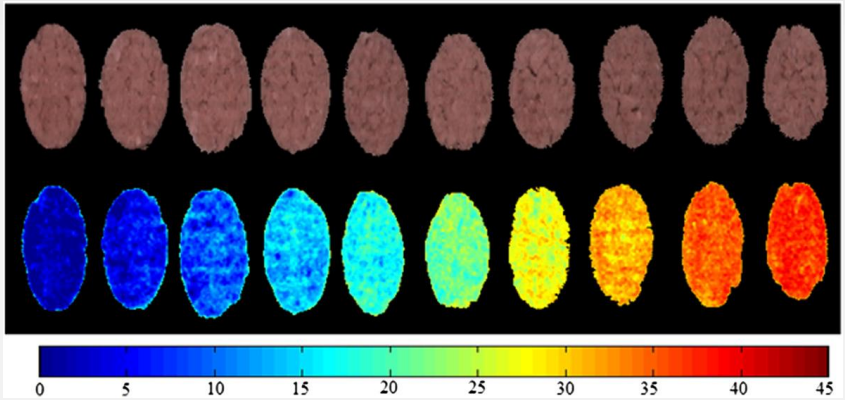




Adulteration, Minced Lamb Meat

Minced meat adulterated with cheaper cuts, offal, or other animal meat:

- Difficult to identify by human eyes
- NIR HSI is suitable for predicting heart adulteration levels in minced lamb meat instead DNA-based techniques and immunological analysis are commonly used [1]



RGB images and corresponding prediction maps of adulteration at different levels (%) [2]

References:

[1] Quantification of Adulteration Levels in Minced Lamb Meat using NIR Hyperspectral Imaging; Y-Y Pu, Y-Z Feng, M. Kamruzzaman, D-W Sun

[2] Fast detection and visualization of minced lamb meat adulteration using NIR hyperspectral imaging and multivariate image analysis;

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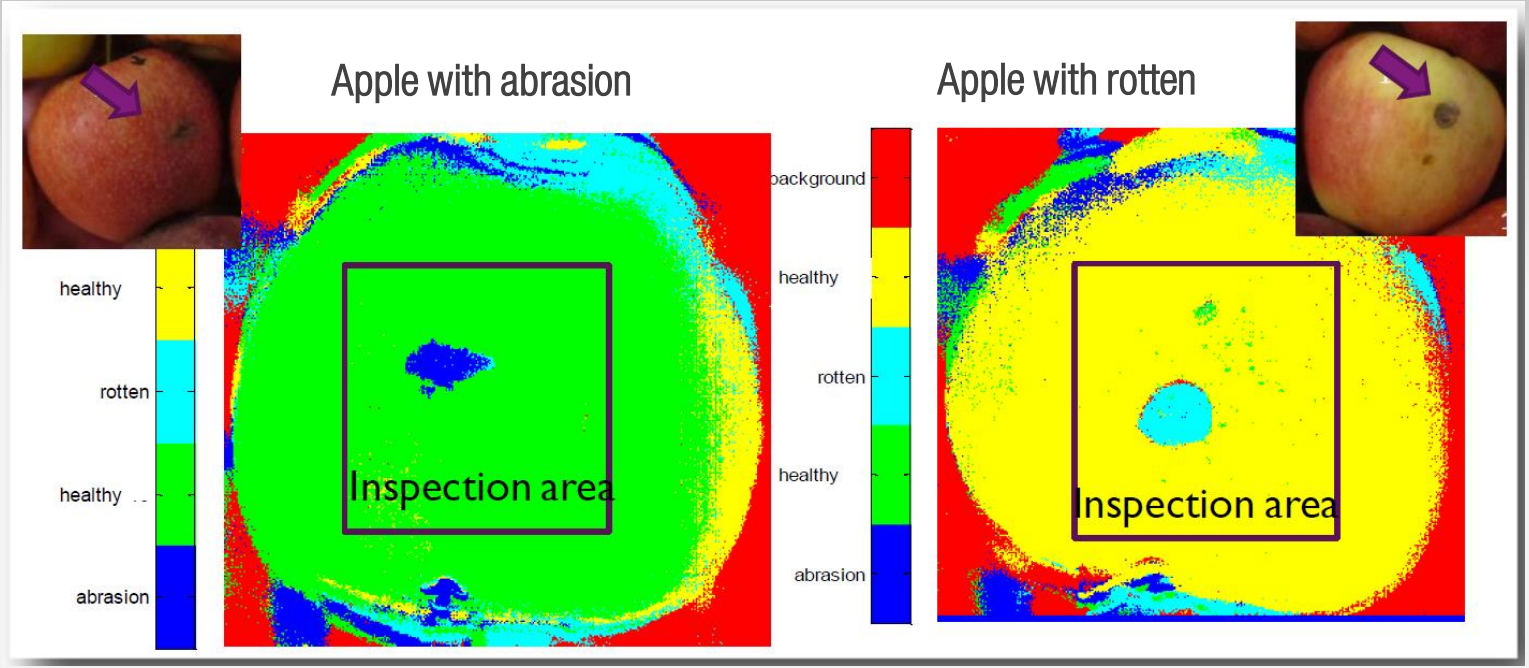
- *Food Refrigeration and Computerised Food Technology (FRCFT), School of Biosystems Engineering, University College Dublin, National University of Ireland, Agriculture and Food Science Centre, Ireland*
- *Ashtown Food Research Centre (AFRC), Ireland*

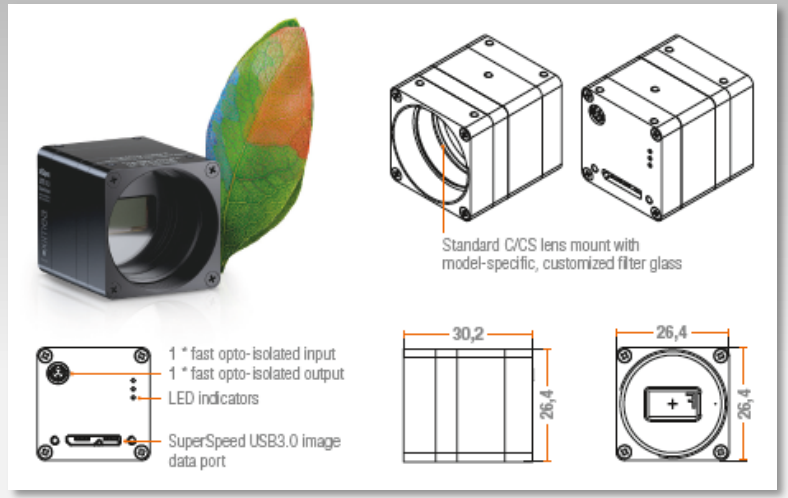
Food quality, bruises

Discrimination of abrasion versus rotten apples using classified images



Based on its spectral response the type of defect can be discriminated accurately

Miniaturized hyperspectral imaging cameras with IMEC sensors



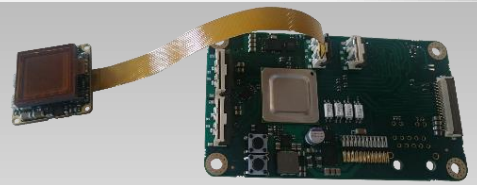
References:

http://www2.imec.be/be_en/research/image-sensors-and-vision-systems/hyperspectral-imaging.html

https://www.ximea.com/en/usb3-vision-camera/hyperspectral-usb3-cameras-mini

Overview of components and workflow

HW / SW component for HSI applications:



- Special VIS-NIR lenses and lighting
- HSI camera(s), additional RGB/mono cameras (optional)
- Massively parallel computational resources (CPU, GPU, FPGA), fast interfaces and storage
- OS, CUDA (optional), HSI image pre-processing software, processing and analysis of the data
- Cameras and system control

Typical application workflow

Data source

- Lighting
- Grab images
- Camera control
- SDK / API

Pre-processing

- RAW images interpretation
- HSI data cube creation
- Data correction

Application specific analysis

- Match spectral signatures against pre-learned references
- Data self clustering, principal/independent component analysis (PCA/ICA), etc.

Other tasks

- Compression
- Stream, store data, etc., if needed

Decisions

- Make decisions
- Control
- Send data
- Others

Thank you for your attention