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# NIR hyperspectral imaging: sampling and penetration depth issues





### **Overview**

**1. Historical overview, spectroscopic and sampling principles** 

2. Instrumentation with small examples

3. Sampling and 3D aspects of hyperspectal imaging

### From the internet (search for 'spectrum')



# Sampling and sampling error (freely after Kim E)

- 1. Material (lot) natural heterogenity
- 2. Grab sampling vs composite sampling
- 3. Sample reduction
- 4. Spatial reduction 3D->2D->1D
- 5. Sampling errors vs. analytical error
- 6. Accuracy and precision

### General: good to have equipment available for -sampling -grinding -mixing -size reduction

### Also important: fractionation!!





Sampling and sampling error

Determine what the goal of the study is and adapt sampling to it

**Grape harvest: lot analysis** 

**Comparing cultivars: 25 grapes of each** 

**Comparing 2 instruments: 5 ml of grape juice** 

**Imaging equipment** 

Homebuilt historical How we started at Röbäcksdalen



### Homebuilt







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## From 2000s Published











### Contour 2D (T)









Scatter 2D (T)

Scatter 2D (T)





t[1]

Grey = non classified 6042 Red = edges 2060 pixels Green = PP 5632 pixels Blue = PP 6264 pixels Orange = PP 6151 pixels Cyan = PET 4136 pixels Magenta = PET 5993 pixels Pink = 2x PET 9958 pixels





Sometimes you don't need advanced algorithms

Just clever subsampling



# Read more!

## 2007

### TECHNIQUES AND APPLICATIONS OF HYPERSPECTRAL IMAGE ANALYSIS

EDITORS HANS F. GRAHN | PAUL GELADI



WILEY



### From about 2005 KBC Published



#### Sisuchema and Umbio

### Sisuchema, FI Umbio, SE









20-40 sec



100 200 300 400 500 600 700 800 900 1000 1100 1200

PHJ+PHM PSJ PSM



# Analysis of 320x ≈1000 pixel mosaics





Wavelength nm

PLS prediction of extractives content Calib on 22 averages Pred pixelwise > 300 000 predictions

See also Lestander, Geladi, Larson, Thyrel JNIRS 2012







#### Videometer LED scan

## Videometer DK

Kempe 2012



## **Different sampling situations**

- Lot to imaged sample(s)
- Always explain how the imaged sample relates to a lot
- Inside samples because you are imaging
- (each pixel is a sample again)
- Describe this situation in sampling terms