Measuring to manage: Spectroscopy can serve the industry

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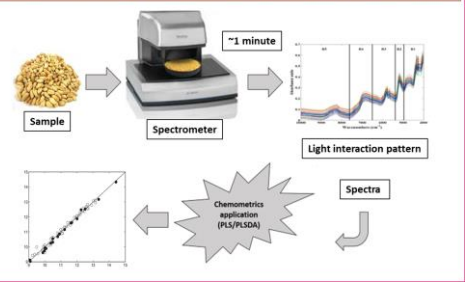
NRC is fostering a healthy, resilient and sustainable future of agri-food production, by promoting measurement:

- Spectroscopy is measurement modality that uses optical energy to analyse the composition of matter.
- It provides a means for quantitative and qualitative analysis of agricultural and agri-food products across the supply chain, including soil.
- It is particularly useful for making routine measurements and enabling instant, on-the-spot decisions in the lab or at a process line.
- Digital spectroscopic repositories can support longer-term tracking (e.g. condition of soil) and production history.
- Some measurement examples include: soil organic carbon, feed profiling and blending (wheat, barley, corn protein), seed content (oil, protein), co-products (starch)…

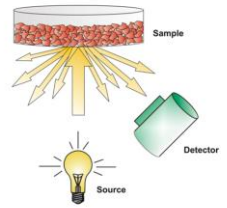
Rapid agri-product analysis

- Spectroscopy captures an optical fingerprint that provides the basis for quantitative and/or qualitative analysis
- Benefit: Spectra and target information stored in a digital file (e.g. for trend analysis)



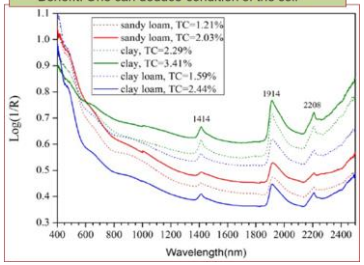
How does it work?

1. Illuminate sample
2. Illumination interacts with sample
3. Detector collects data to create spectrum
- Benefit: Non-destructive, no sample prep



Spectra of soil

- A spectrometer captures a spectrum from a sample
- A spectrum contains the feature-rich fingerprint
- Benefit: One can deduce condition of the soil



Multiple targets can be analyzed in a single measurement

- Training or calibration is the process by which an analytical method is generated to provide rapid results of all prescribed targets of interest
- The analytical method is the process behind the scene
- The method analyses the fingerprint features of a spectrum to extract the information of interest
- Benefit: Once calibrated, measurements can be done for virtually no cost

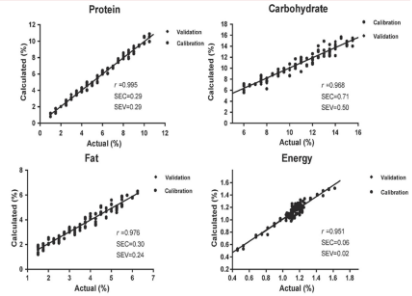
Simultaneous Analysis

- Protein
- Carbohydrate
- Fat
- Energy (derived)

Instant Measurement

Instant Knowledge

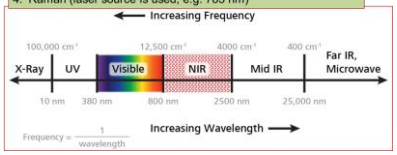
Instant Response



Y. Deng, Y. Wang, G. Zhong, and X. Yu. "Simultaneous quantitative analysis of protein, carbohydrate and fat in nutritionally complete formulas of medical foods by near-infrared spectroscopy". Infrared Physics & Technology, Volume 93, September 2018, Pages 124-129

Suitable types of spectroscopy for agri-products

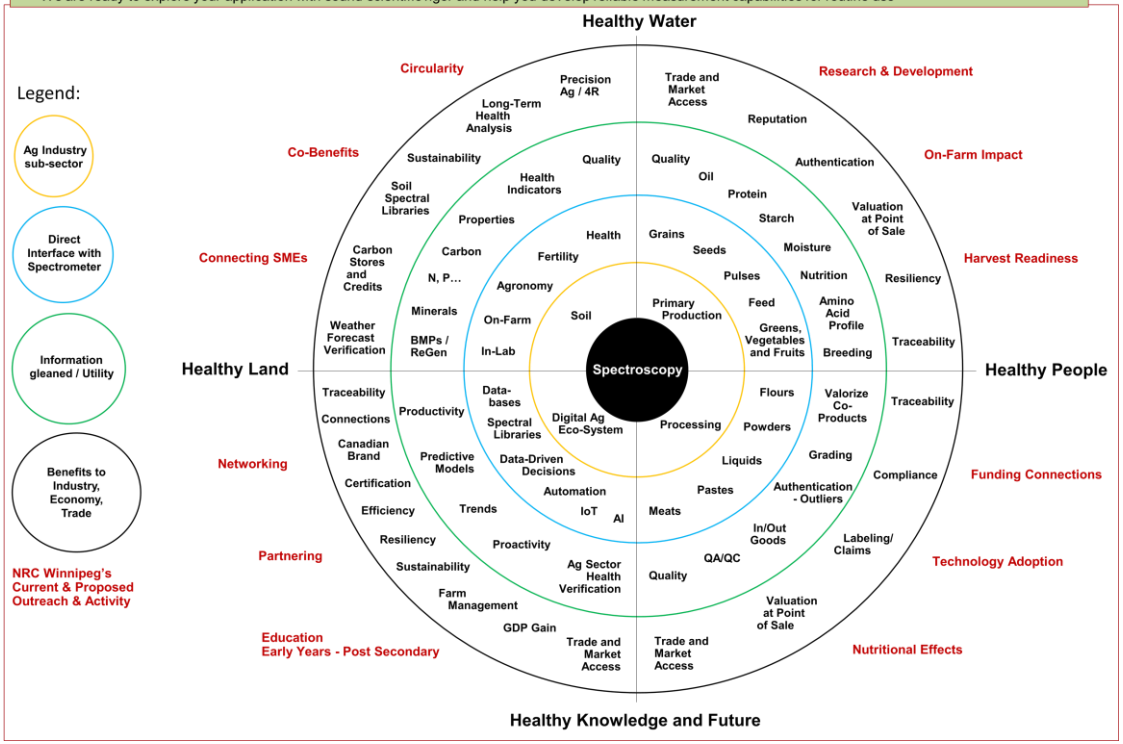
1. VIS-NIR (400 – 2,500 nm)
2. NIR (780 – 2,500 nm)
3. MIR (2,500 – 25,000 nm)
4. Raman (laser source is used, e.g. 785 nm)



Agri-products suited to spectroscopy

NRC Winnipeg is connecting Canadian priorities with this measurement system to help build a holistic and prosperous Canadian digital ag ecosystem

- NRC Winnipeg is set up to de-risk the adoption of this technology where it will create business and economic benefit – with agri-products and players at our focal point
- We have access to all spectroscopic types mentioned herein, and have recently invested in several low-cost, state-of-the-art, off-the-shelf NIR hand-held devices
- We are ready to explore your application with sound scientific rigor and help you develop reliable measurement capabilities for routine use



Training / calibrating / developing the analytical process:

- 10s to 100s of samples are typically used, each with quality reference data that has been measured by other validated, standard methods.
- Reference data for each sample can include measurements for multiple targets of interest.
- Spectra for each sample are correlated to their corresponding reference data, from which the analytical method is formulated.
- The same instrument can host a plethora of different calibrations for different agri-products and/or targets of interest.
- Once calibrated, the spectrometer can provide ongoing measurements and digital records at virtually no incremental cost.

Summary:

- Spectroscopy in an amazing technology for measuring agri-products and processes, instantly and non-destructively.
- NRC Winnipeg is focused on the priorities of the Canadian ag-tech communities and is set up to de-risk the adoption of this technology where it will create business and economic benefit.

"Imagine: A healthy and holistic agri-food production system, one in which all important points along the supply chain involve simple measurement, thus creating a traceable, information- and value-based system of our products and processes"