Instant Monitoring of Food Quality

“Applications of spectroscopy from the farm to the fork”

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Overview

• Spectroscopy and its applications
• The MEMS microspectrometer
• Example applications in the food supply chain
  – On farm
  – At distribution/retail outlets
  – In the home
Spectroscopy and its applications

• Measures “colour” content of light,
  – Examines how the colour content is selectively absorbed/reflected by various materials.
  – Produces an optical “fingerprint”
• Spectroscopy finding increasing application in food industry
  – Agriculture (Growth)
  – Process control
  – Not so much in distribution (yet)
  – Not at all in the home (yet)
• Generally spectrometers are bulky and expensive
  – 10’s of kg
  – ~$50,000 - $100,000
  – Fragile and sensitive to vibrations
  – Need routine maintenance

http://michaeljacksun123.blogspot.com.au
http://kuthirummaln.people.cofc.edu
What are MEMS

- **Micro Electro Mechanical Systems**
  - Micro-scale mechanisms
  - Can generate motion on the micro-scale
  - Driven Electrically
  - Fabricated using same processes as IC technology

http://www.memx.com

http://www.princeton.edu/mae/people/faculty/soboyejo/research_group/research/mems/


MEMS for Spectrometry

• Initially developed for spectral imaging applications (defence)
  – Wavelength agile detectors for chemical identification
  – Improved target identification and detection

• Use MEMS technologies to acquire spectral measurements
  – Small and light-weight
  – Robust to vibrations
  – Potentially very low cost (leveraging IC technologies)
How does it work?

- Spectral filters created by separating mirrors a distance 'd'
- Filter tuned by moving top mirror
- Mirror moved electrically
Example applications
Grain drying

- Present
  - Air pumped through bin/tower containing wet grain
  - Location of moisture front unknown
  - General practice over-estimates drying time to ensure full drying
  - Significant fuel wastage because end point of drying is unknown

- With MRG Spectrometer
  - Moisture front can be monitored as it moves upwards through the bin
  - Drying can be stopped as soon as moisture front leaves surface of grain pile
  - Saves time, fuel, $$$
Faecal contamination in meat

- Feecal contamination in meat is:
  - completely unacceptable
  - completely unavoidable
- Infrared spectroscopy has been shown to successfully detect faecal contamination in poultry
- However, widespread application is hindered by cost.

Other applications

• Fresh Produce
  – Testing optimal ripeness
  – Testing pesticide contamination
  – Testing for rotten fruit

• Food forensics
  – Detecting source (Milk, Wine)
  – Detecting contaminants/additives (eg. Melamine in milk)

• Detecting freshness/expiry
  – Fruit/Vegetables
  – Milk
  – Meat

http://www.winenoviceinfo.com
And finally... the ultimate personal food quality monitor

- Smart phones commonly contain
  - GPS
  - Compass
  - Accelerometers
  - Camera (still & video)

- Why not a personal spectrometer incorporated into smart-phone

- For on-demand testing of:
  - Freshness of produce
  - Tampering/Counterfeit products
  - Contamination
    - Pesticide residues in fruit/veg
    - Allergens in processed products (anaphylaxis)


http://www.digitaltrends.com/cell-phone-reviews/apple-iphone-5-review/