

Aerial Imaging

Advantages:

- Higher resolution than satellite
- No restriction on revisit time
- High payload capacity
- Active or passive sensors
- Long flight time
- Power delivery
- Data storage capacity

Disadvantages:

- Flexibility of timing
- Some image mosaicking may be necessary
- Cost inhibitive for smaller fields



UAV imaging



Advantages:

- Higher resolution than satellite and often aerial
- No restriction on revisit time
- Short flight time
- Active or passive sensors
- Flexibility in height above canopy

Disadvantages:

- Low payload capacity
- Restricted power delivery
- Intensive image mosaicking necessary
- Quality of data varies widely

Proximal sensing for spectral reflectance

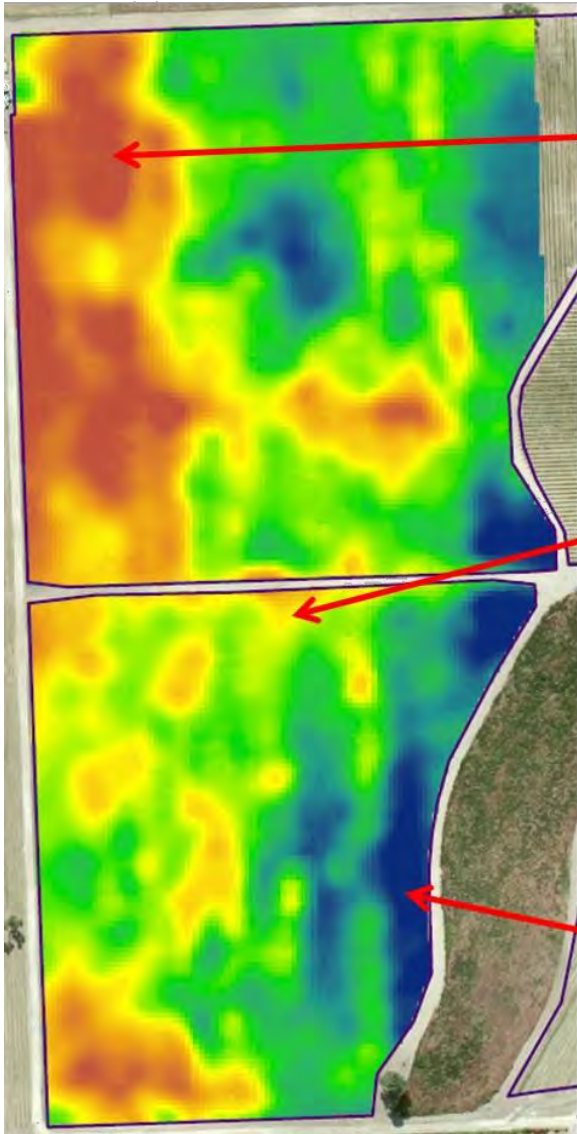


Modulated Polychromatic LED array

Silicon Photodiodes @ 730nm, NIR and 670nm



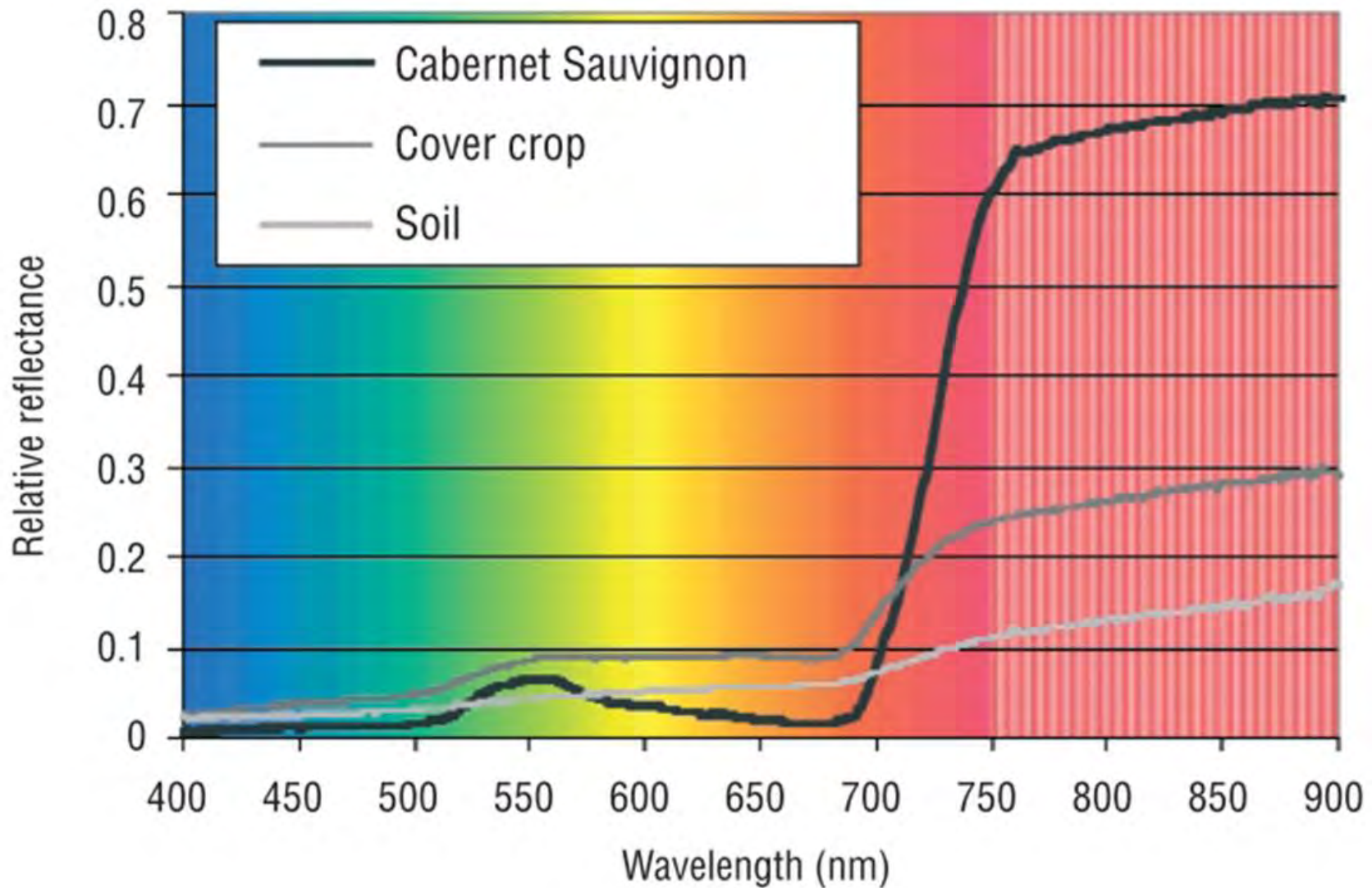
From signal to map



Proximal Sensors:

- Aimed directly at area of interest
- Active sensors (emit light)
- Sensors for specific wavelengths
- Maps show areas of relatively high, med, low canopy fill

Spectral Reflectance of Cab Sauv



Compared to active grapevine leaves:

Bare Soil

- Relatively low NIR reflectance
- Relatively high Red reflectance

Cover Crop

- Species dependent
- Relatively low NIR reflectance
- Relatively high red reflectance

New sensor development

Now:

- Red, Red edge, NIR reflectance
- Relative patterns
- Correlate to leaf area, pruning weight



Image from: Luke Haggerty, Cornell University

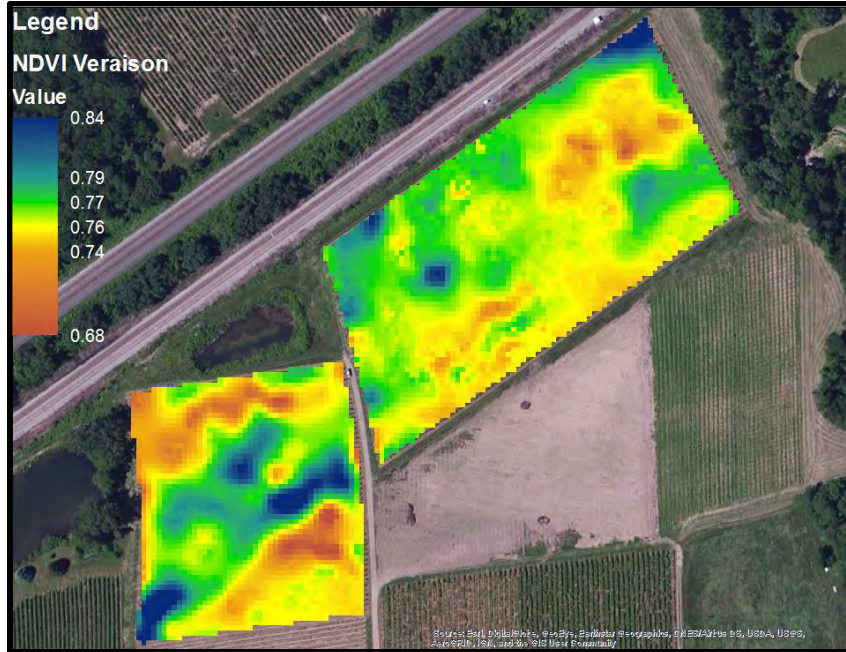
Future:

- High resolution RGB
- Absolute patterns
- Directly estimate exposed leaf area, pruning weight



Image from: Abhi Silwal, Carnegie Mellon University

Sensor validation



NDVI

- Relative patterns
- Highs and lows in canopy fill
- Highlights problem areas



Stratified Sampling

- Validates sensor signal
- Correlations can be used to translate
- Output is absolute legend

Horizontal Spectral Imaging Cost

- Acquisition Costs
 - Crop Circle Package \$8,000 - \$9,000
 - Ag Leader
 - \$9,500 - \$11,000
 - Tractor computer and GPS represents most of that cost
- Georeference & Orthorectification
 - Free to project participants
 - Project goal of \$10 - \$30 per image or \$2 - \$6 per acre
 - Farm manager cost
 - Farm owner unpaid labor
 - Ag Leader Data Processing included
 - Soil validation is \$9 - \$15 per acre
- Image Processing
 - Ag Leader included with SMS Advanced but less robust
 - At least \$30 per acre with open source or crop circle
 - Project goal to reduce cost by 50% or more



Vertical Spectral Imaging Cost (2015)

- Satellite \$2,650
 - Acquisition \$2,500
 - Georeference \$50
 - Image Processing \$100
- Aircraft \$3,800
 - Acquisition \$3,000
 - Georeference \$500
 - Image Processing \$300
- UAV \$5,300
 - Acquisition \$4,000
 - Georeference \$1,000
 - Image Processing \$300
- Crop Circle \$2,600
 - Acquisition \$100
 - Georeference \$1,500
 - Image Processing \$500
 - Grower Owned



Matese A, Toscano P, Di Gennaro SF, Genesio L, Vaccari FP, Primicerio J, Belli C, Zaldei A, Bianconi R, Gioli B. Intercomparison of UAV, Aircraft and Satellite Remote Sensing Platforms for Precision Viticulture. *Remote Sensing*. 2015; 7(3):2971-2990.

Contact Us

- Jackie Dresser
jd929@cornell.edu
716-792-2800
- Kevin Martin
kmm52@psu.edu
716-792-2800

