Comparing Hyperspectral and Multispectral satellite imaging for within-field maize yield prediction using Support Vector Machine

Maize Crop Yield Prediction

Through the years, has been;

1. **Casual/Mental model**
2. **Scientific model**

a) Soil conditions (too manual)

b) Weather conditions (too many variables)

c) Appearance – models built for V. Healthy, Healthy, Average, Poor, V Poor.

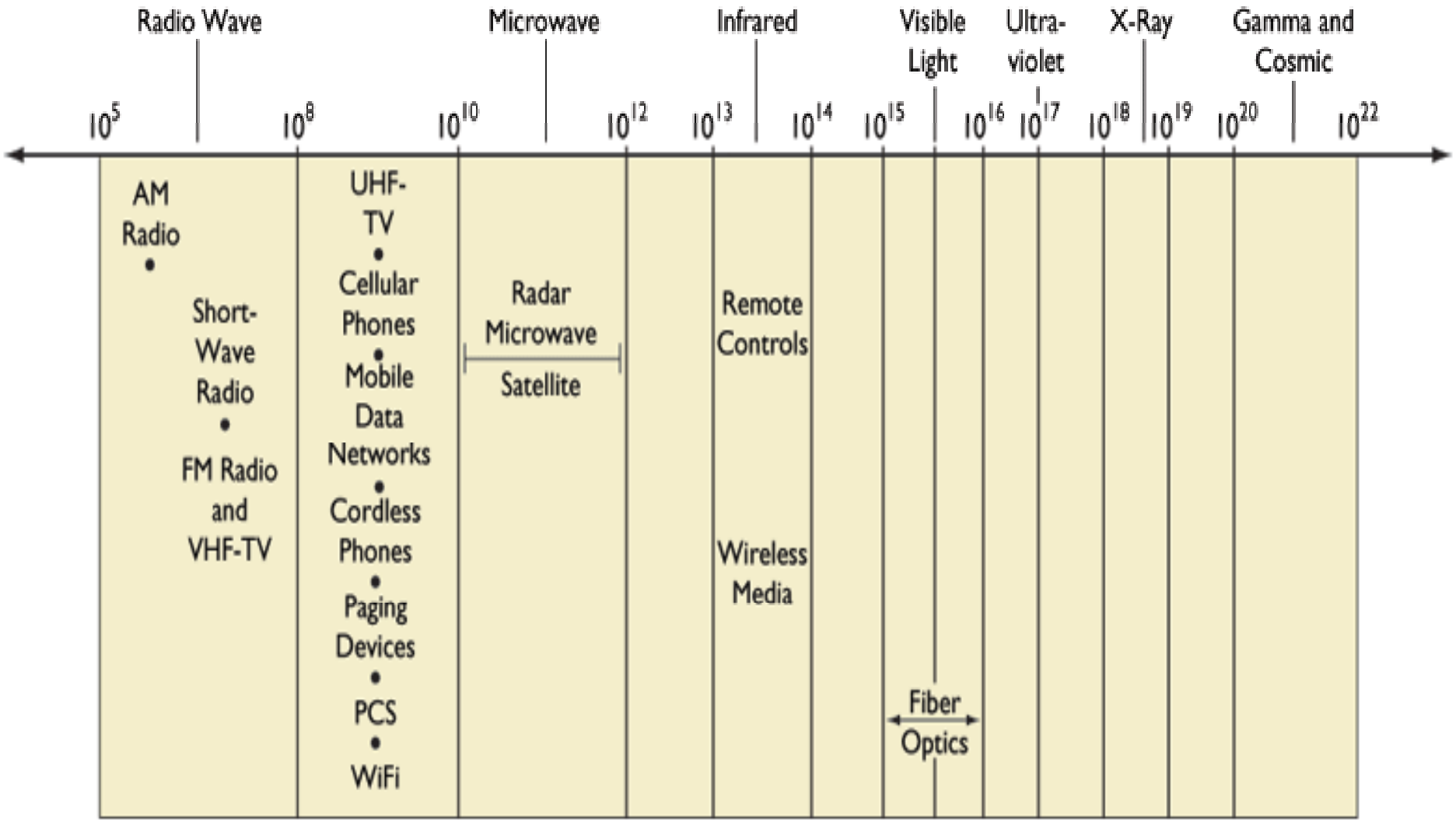
Crop Data Collection

1. **Localized (**Mechanistic and chlorophyll Analysis**)**
2. **Remote-sensing**

Mainly satellite and aircraft platforms. Has used visible cameras etc. Now;

- Multispectral – 20 bands,100nm width bands.
- Hyperspectral – 200 bands, 10nm width bands.

Illustrated in next slide;


Radio Wave
Microwave
Infrared
Visible Light
Ultra-violet
X-Ray
Gamma and Cosmic
10^5
10^8
10^{10}
10^{12}
10^{13}
10^{14}
10^{15}
10^{16}
10^{17}
10^{18}
10^{19}
10^{20}
10^{22}
AM Radio
Short-Wave Radio
FM Radio and VHF-TV
UHF-TV
Cellular Phones
Mobile Data Networks
Cordless Phones
Paging Devices
PCS
WiFi
Radar
Microwave
Satellite
Remote Controls
Wireless Media
Fiber Optics

Platforms;

a) **Satellite** – quick, cheap, wide coverage. But poor spatial resolution for hyperspectral imaging (30m). Regional.

b) **Airborne** – Good spatial resolution (2m), within-field. But too expensive for the African researcher

Problem Statement

- In Kenya/Africa, majority of maize is grown in small, proprietal plots of approx. 2 acres

- Due to differences in quality of farm inputing and general farm management across proprietal plots, yield is likely to vary across the plots.

Problem Statement cont'd

- Analysis of crop health is best done with the plots as the basic units, then aggregated over locations, districts, provinces and nationally.

- This calls for within-field imaging.

- Has been only possible with airborne imaging, which is too expensive.

Hypothesis

- The study explores the use of satellite for within-field (120m * 120m plots) imaging.
- The study hypotheses that using multispectral and hyper spectral technologies for data collection can generate enough pixels per plot for analysis.
- 6 pixels per image is enough for analysis

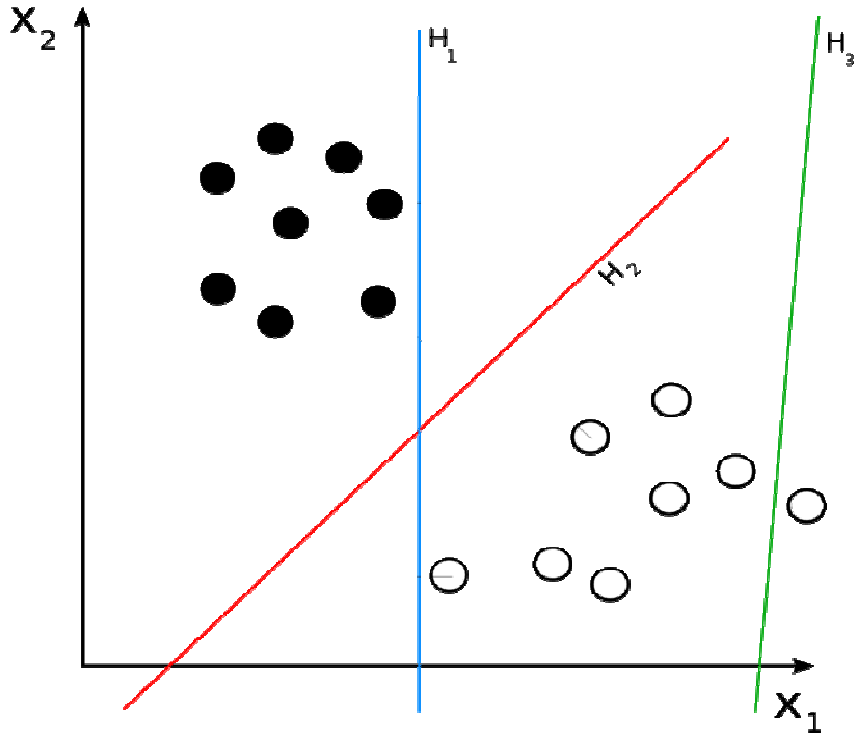
1. Hyperspectral – @ 30m resolution, 16 pixels
2. Multispectral - @ 2m resolution, 3600 pixels

Methodology

- Five 120 m * 120 m plots; V Healthy, Healthy, Average, Unhealthy, V Unhealthy.
- Replicated 4 times, the other three for evaluation of accuracy
- Tend till harvest and record bags/acre for each plot
- Build model by mapping spectral values of each plot to the yield

Analysis

- To be done using SVM (Support Vector Machine), according to empirical research findings, the most powerful machine learning (Artificial Intelligence) algorithm.
- Viewing input data as two sets of vectors in an *n*-dimensional space, an SVM will construct a separating hyperplane in that space, one which maximizes the *margin* between the two data sets.



- H3 (green) doesn't separate the 2 classes. H1 (blue) does, with a small margin and H2 (red) with the maximum margin.

PRESENTER'S DETAILS

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