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Analysis and Application of Multispectral Image Processing Techniques Applied to Soybean Crops from Drones Vision System

Evelio González, Cristhian Núñez, **José Salinas***, Jorge Rodas, Mariela Rodas, Enrique Paiva, Yasine Kali, Maarouf Saad, Fernando Lesme, José Luis Lesme, Luis González, Belén Maldonado, José Rodríguez-Piñeiro

Unidad Pedagógica de Caacupé, Universidad Católica Nuestra Señora de la Asunción, Caacupé, Paraguay.
Email: jzsalinas@gmail.com

Agenda

- **01 – Introduction**
- **02 – Multispectral Image obtained by drones**
- **03 – Imaging Processing Techniques**
- **04 – Conclusions**
- **05 – Acknowledgements**

01- Introduction

Drones are important in precision agriculture applications since they represent a new tool that can increase crop production. In this context, the digital processing of the images obtained from multispectral cameras integrated into the drones makes it possible to analyze the stress state of the crops, their vigor, a burned area, among others. The latter are usually obtained through proprietary applications with very high subscription costs. For this reason, this article presents the step-by-step implementation process of the different methods or algorithms to be applied to multispectral images using the open-source Python programming language. We use a soybean crop as an example of the application, and the results obtained from applying the digital image processing algorithms are presented.

02 - Multispectral images obtained by drones

Most of the drones available in the market typically have mounted an RGB camera. These types of cameras mount a sensor that measures the capacity of light within the visible spectrum. That is, the spectrum that the human eye is capable of seeing. With an RGB camera, we will only capture and interpret colors as we see them. Therefore, we can only detect problems that are already visible to the naked eye from an aerial view, such as areas with little vegetation. Other ranges of radiation in the electromagnetic spectrum go beyond RGB and are of great importance for precision agriculture. To see this type of radiation (the human eye is unable to see them), we need a multispectral sensor. Multispectral cameras have this type of sensor capable of capturing various spectra of light.

03 - Imaging Processing Techniques

- **NDVI**
- **GNDVI**
- **SAVI**
- BAI
- CIg
- CIre
- GEMI
- MSAVI2
- MTVI2
- NDRE
- NDWI
- RTVICore
- SRre

03 - Imaging Processing Techniques

- Bands of Multispectral Camera:

    - ***R***: Red
    - ***G***: Green
    - ***B***: Blue
    - ***RGB***: (human eye vision band)
    - ***NIR***: Near-Infrared
    - ***RE***: Red-Edge

03 - Imaging Processing Techniques

- NDVI: Normalized Difference Vegetation Index

$$NDVI = \frac{NIR - R}{NIR + R}$$

It represents an index that allows you to generate an image showing greenness (the relative biomass). Taking advantage of the absorption of chlorophyll pigment in the ***R*** band, and the high reflectivity of plant leaves in the ***NIR*** band.

03 - Imaging Processing Techniques

- GNDVI: Green Normalized Difference Vegetation Index

$$GNDVI = \frac{NIR - G}{NIR + G}$$

It is like NDVI but resistant to atmospheric effects since it has a more excellent range of wavelengths. GNDVI is five times more sensitive to the concentration of chlorophyll-a.

03 - Imaging Processing Techniques

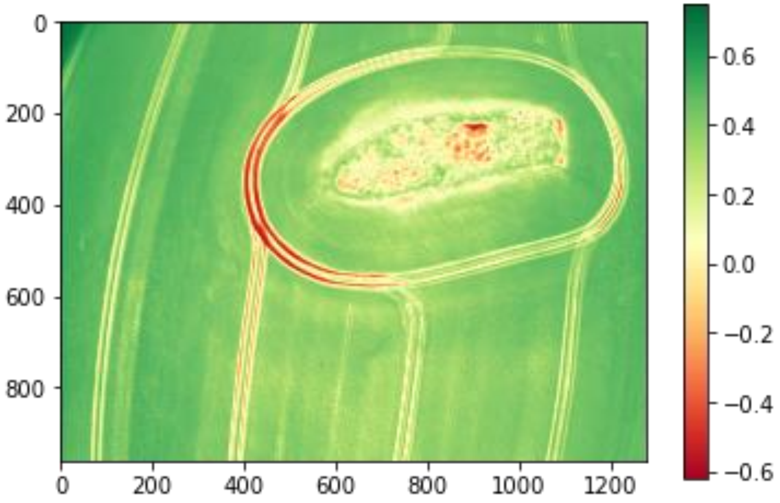
- SAVI: Soil Adjusted Vegetation Index

$$SAVI = \frac{NIR - R}{NIR + R + L} + (1 + L)$$

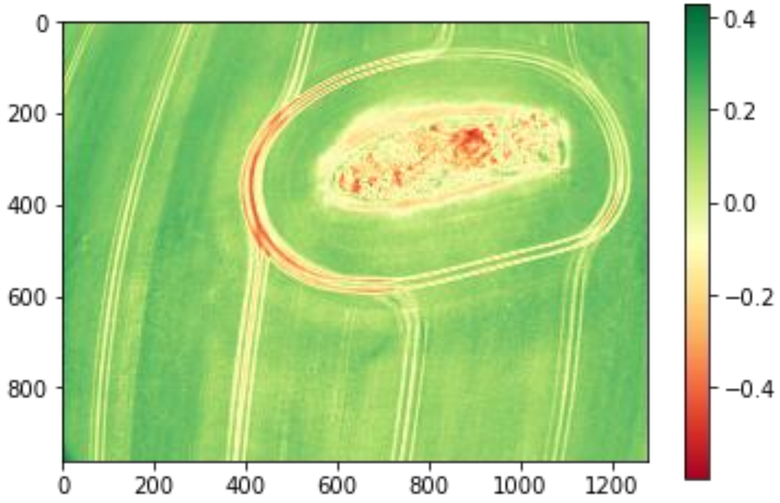
Is an index that attempts to minimize the influences of soil brightness by using a brightness correction factor. SAVI is regularly using in arid regions where vegetation cover is low. ***L*** can take different values depending on the amount of vegetation in the area of interest and vary between -1 and 1.

03 - Imaging Processing Techniques

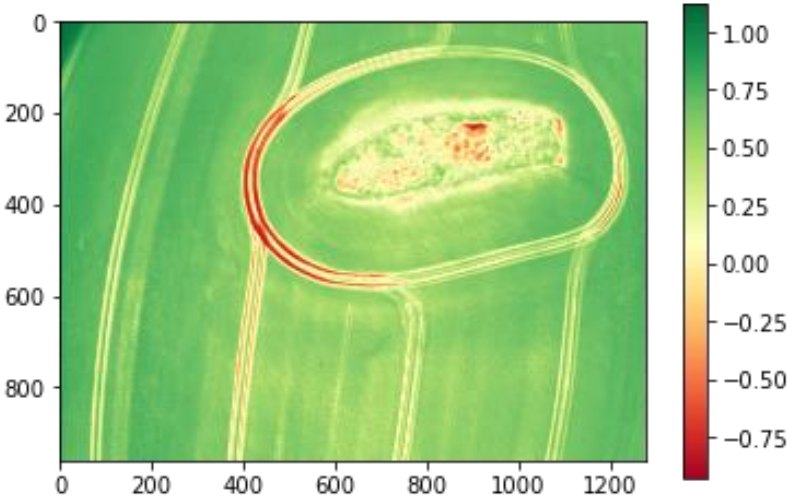
NDVI



GNDVI



SAVI



03 - Imaging Processing Techniques

Source code in Python Programming Language

```python
# {Start with the import of the modules necessary}
import rasterio
from rasterio import plot
import matplotlib.pyplot as plt
import numpy as np
import os

# {Read the R band}
imgPath = 'C:/Img/'
red = rasterio.open(imgPath+'IMG_0142_RED.TIF')
# {Read the NIR band}
nir = rasterio.open(imgPath+'IMG_0142_NIR.TIF')

# {Convert to float}
red = red.read(1).astype('float64')
nir = nir.read(1).astype('float64')
```


red = red.read(1).astype('float64')
nir = nir.read(1).astype('float64')


```python

# {Error handling in the division}
np.seterr(divide='ignore', invalid='ignore')

# {Calculate NDVI using numpy arrays}
# {no data is complete with zero}
ndvi = np.where((nir + red) == 0., 0,
                (nir - red) / (nir + red))

# {Plot the results with the colors}
# {Red, Yellow and Green}
plt.imshow(ndvi, cmap='RdYlGn')
# {Add color palette}
plt.colorbar()
```

04 - Conclusion

This research work has addressed the use of drones in agriculture. Different algorithms used by commercial applications have been analyzed, also incorporating others. Then we have studied a soybean crop and applied the different algorithms using an open source programming language. The programming process for each algorithm has been presented to be applied directly to readers and the results obtained have shown their correct operation.

05 - Acknowledgements

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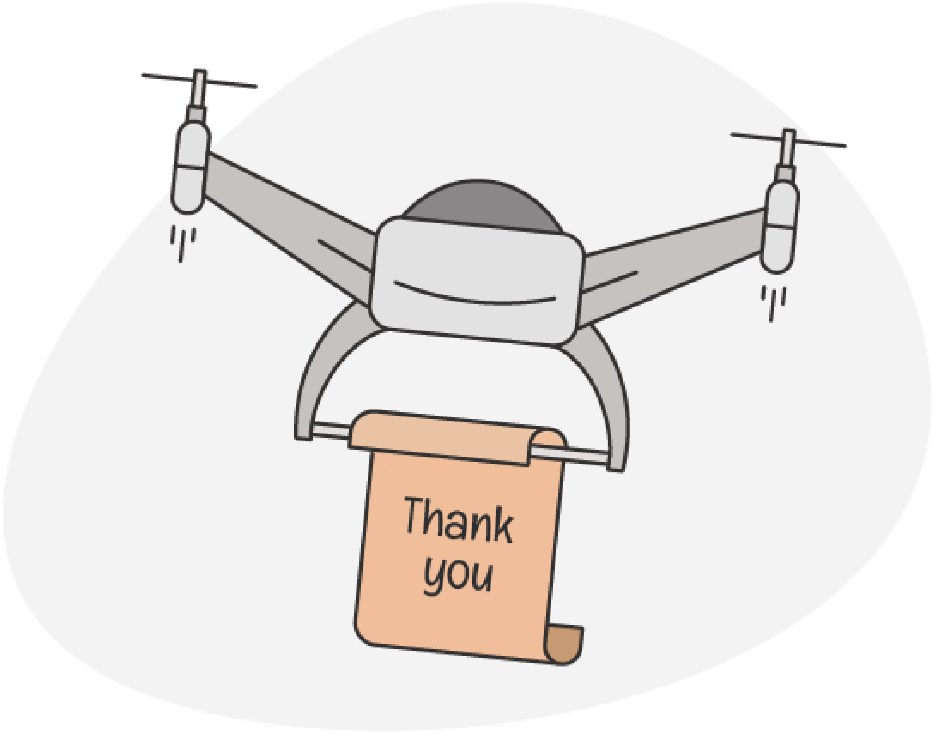

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