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Index Set Green Cover Method for Automated Identification of Vegetation

Denison Lima Correa[1], Marcelo Augusto Machado Vasconcelos[2], Paulo Celso Santiago Bittencourt[3], Jorleide Rodrigues[4]

[1]Msc in Water Resources, University Federal of Para, Brazil
Email: denison.singeo@gmail.com
[2]Geoprocessing Technology school, Federal University of Para, Brazil
E-mail:vasconcelos@ufpa.br
[3]Geoprocessing Technology school, Federal University of Para, Brazil
E-mail:paulocsb@ufpa.br
[4]Student of Forest Engineering, University Federal rural Amazon, Brazil
Email:jopgml3@hotmail.com

***Abstract*— *The objective of this study was to generate a new methodology for the generation of vegetation index by drone cameras for the quantification of green cover area. For this study a drone of the DJI Mavic PRO quadricopter model was used. The flight plan was made using the Drone Deploy application and a total of 56 images were obtained, with a 60% side cover and 70% front cover. The images were processed in the professional Photoscan software version (1.4.2) resulting in mosaic area. The following ICVA equation was applied: ((pGreen-pRed / pGreen + pRed) * L) through the map algebra of ArcGis 10.3. The vegetation index was thus generated, without the need to use satellite images or multispectral data and thus generates a new way of identifying vegetation with the use of drones, Vants and RPAs, being a landmark in the advancement of studies of geotechnologies. The equation used will still be tested in new areas and different situations to show its capacity, and if necessary will be improved according to the observations made.*

Keywords*— *Geotechnology, Drone, Mapping, Vegetation.

I. INTRODUCTION

Aber et al. (2010) presents an extensive history of applications and development using small format photographic images. Ramos and Bueno (2007) present some pioneering projects in the country. Recently, systems based on Remotely Piloted Aircraft have evolved with the development of flight controller boards, some with open hardware and software, such as the APM (APM, 2016) and Pixhalk (MEIER, 2016) boards. This development allowed the appearance of cheap platforms and easy operation. Jorge and Inamasu (2014) present the current state of technology and applications in agriculture.

For the field survey of the soil cover by woody species one of the most used sampling methods is the intersection in lines. In order to do so, it is not necessary to use more than one scale and the estimates for the estimation are simple, and the result is expressed by the percentage of area covered by woody vegetation (MELO et al., 2010).

However, the soil cover presents a great potential to be verified by remote sensing, since the spectral response of the forest cover is a prominent feature in aerial images obtained with diverse sensors.

The information from platforms such as drones, Vants and RPAs have peculiar characteristics in relation to the set of data traditionally used in Remote Sensing for allowing to work in low altitude, generating data of high resolution. Due to the low image acquisition altitude, spatial resolutions can be in the order of magnitude equivalent to a unit of centimeter. At this level of detail, a single flight can generate up to 100 ha depending on time, altitude, speed and flight planning.

The traditional vegetation indexes allow us to generate very precise results when well rectified and adjusted, since most satellites have within their spectral region the ability to work with infrared allowing the generation of IV. Drone cameras are programmed in the region of the visible and factory do not have the ability to perform IV, but there is the ability to purchase cameras specifically for this purpose. In this situation, the need arises to use methodologies for the generation of Vegetation Indices without the need of the infrared region.

In this sense, work like the one of (NEVES et al., 2017) present a proposal of a method to generate a Green Coverage Index (ICV) for application from images of very high resolution. It can be applied to images acquired by ordinary cameras, without the need to use the infrared channel. It uses the color space represented by the hue, saturation and brightness components, referenced in the

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literature as HSB or HSV (Hue, Saturation and Brightness / Value) (CHANG et al., 2010). This space easily allows the separation of a certain color (hue), initial step in the proposed method. The features of this index allow you to obtain information on the relative amount of pixels with green tones in an area. A more specific application for agriculture is to accompany the development of a crop from its germination / sprouting, perceiving the failures in planting and problems in its development.

So the objective of this study is to generate a new methodology for the generation of vegetation index by drone cameras for the quantification of green cover area.

II. APPLIED METHODOLOGY

For this study a drone of the DJI model model Mavic PRO (Figure 1) of 12.35 Megapixels was used. This aerial vehicle is equipped with a sensor 1 / 2.3 "CMOS RGB (Red, Green and Blue) has a camera metric type of angular Supergrande format with opening of approximately 88 °. The images were obtained on May 14, 2018 flying at an altitude of 75 m.

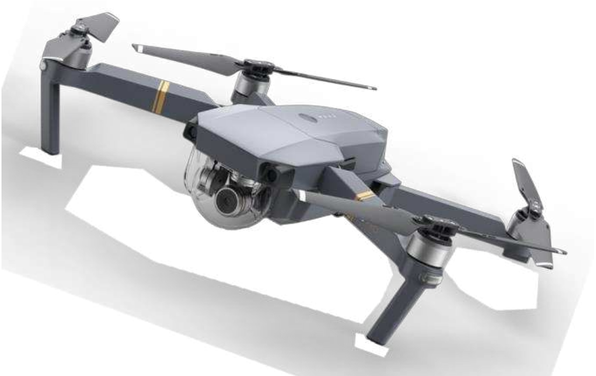

Fig.1: Drone Mavic PRO.
Source: (DJI)

A of the most significant advantages of using this equipment for this experiment is that it incorporates in its characteristics concerns related to traditional photogrammetry such as flight stability by inertial sensors and GPS, constant height, information records of the entire route flight scheduling, image georeferencing, and flight planning scheduling ease.

The study area was on the campus of the Para State University (UEPA) campus Paragominas, with coordinates 47º 21 '32 "at 47 ° 21' 33" W longitude and 02 59 '05 "at 02 59' 10 South latitude with an area of approximately 1.6 hectares.

The flight plan was done using the Drone Deploy application and in total 56 images with 88 ° capture angle were obtained, with a 60% lateral cover and 70% frontal cover. The images were processed in the professional Photoscan software version (1.4.2) resulting in mosaic of the area, and later the orthophoto was georeferenced with 15 control points distributed in a way that can control the limits of the property, this collection was done by transporting coordinates by topography with the use of total station so it was exported in *GeoTiff* format with a resolution of 2.5 cm / pixel.

For the generation of the Adjusted Green Coverage Indices (ICVA) term used in this work, the software ArcMap 10.3 (ESRI) was used that from the orthophoto exported by the photoscan software, the following equation was proposed:

$$ICVA: \frac{PGreen - PRed * (L)}{PGreen + PRed}$$

PRed: Reflection of the Red region
PGreen: Reflection of the Green Region
L: Opening the equipment lens

The spectral bands used in the calculation of the index make a relation between the greater absorption of the electromagnetic energy by the active vegetation in the spectral range of red and the greater reflection in the green region. The index varies from -1 to +1, and negative values are associated with greater presence of exposed soil, water and infrastructure (constructions) and positive values for the presence of vegetation. As there was no information available on the Mavic Pro drone sensor, it was not possible to convert the digital number to reflectance. However, the index was calculated directly with this equation bringing satisfactory results.

III. RESULTS AND DISCUSSION

The results of this study were surprising and proved to be effective with the equation used, the work of Neves et al. (2017) who used the green tint to approximate the vegetation cover result, stated in his study that the application shows that the method is not effective to differentiate areas completely occupied by vegetation. This fact, which with this new proposal of equation, can better adjust the vegetation coverage information, but classifying it at successional levels is not yet possible, because the vegetation reflectance is not well differentiated within the drone camera.

The characteristics of this new set of information and the challenges associated to its use, such as deformations and image degradation, can be rectified using techniques and methods available in areas related to Remote Sensing, such as computer vision, in typical problems of stereographic vision, multiple views, Digital Land Models, object reconstruction, among others. This new reality does not represent a threat to orbital SR and airborne by manned vehicles, but rather, it expands its possibilities, being a great challenge the development of new methods and approaches more appropriate to this dataset. Below in figure 2 and 3 we have the representation of the processes and their due results.

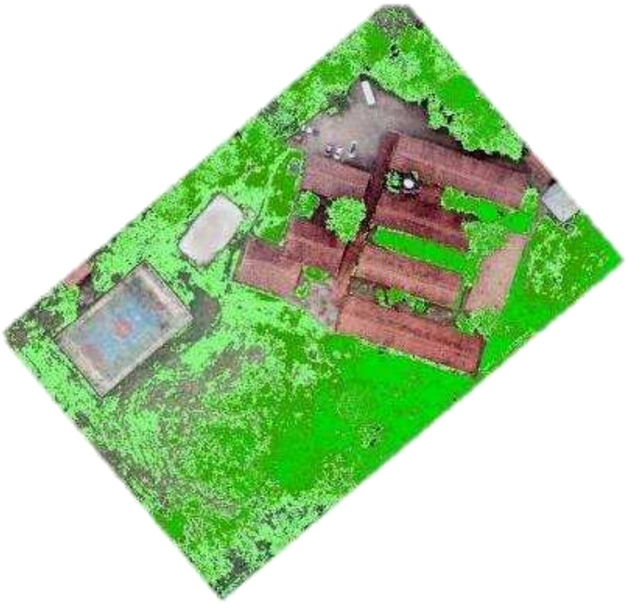

Fig.2: Composition between orthophoto and ICVA.

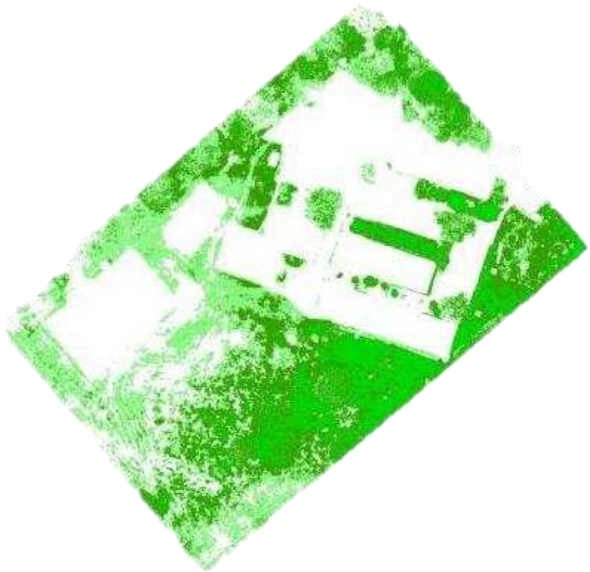

Fig 3: Extraction of vegetation area

In figure 2 we can observe the ICVA overlapping the orthophoto and can make clear its interaction and its prominence where exposed soil and buildings did not generate a confusion matrix, in figure 3 we have the extraction only of the green cover, in this case it is not possible to classify the vegetation in successional states, since we observed that the behavior of the green cover does not take into account the leaf area or the spectral response, but rather the reflectance of the green cover.

We can observe that the methodology of Green NDVI, used by Gitelson et al. 1996, a variant of NDVI, is used to identify different rates of chlorophyll concentration in vegetation, since the green band is more sensitive to detect nutritional levels of a plantation. This index is widely used at the beginning of the harvest period, where nutritional levels are varied. However, the SAVI index, proposed by Huete (1988), decreases the effect of soil on different densities of the vegetation cover in the soil, that is, it considers the influence of the soil on the vegetation. Considering the use of sensors, several authors found good correlations in the late stages of the plant. Teal et al. (2006) find better correlations between NDVI and productivity at these stages. Clay et al (2006) showed that the recommendation of N based on NDVI collection in the final stages was more accurate than models based only on productivity. In addition, when using the sensors it has the benefit of quantitatively identifying the spatial variability of the culture (MARTIN et al., 2007). Thus, we can observe that some works correspond to the ICVA proposed in this study.

IV. CONCLUSION

This study generated satisfactory results and proved effective in generating the Adjusted Green Coverage Index, without the need to use satellite imagery or multispectral data. Thus this is a new way of identifying vegetation with the use of drones, Vants and RPAs, being an advance of the studies of the geotechnologies.

The equation used will still be tested in new areas and different situations to show its capacity, and if necessary will be improved according to the observations made. The method can be used to generate green cover and identify tree targets.

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REFERENCES

[1] ABER, J. S.; MARZOLFF, I.; RIES, J. B. (2010) Small-format aerial photography principles, techniques and geoscience applications. Amsterdam: Elsevier Science, 268 p. ISBN: 978-0-444-63823-6.

[2] CLAY,D.E.; SCHUELLER,J.K.;MILLER,W.M; WHITNEY,J.D.; CORNELL,J.A. (2014) Error sources affecting variable rate application on nitrogen fertilizer, Precision Agriculture, New York, v. 5, p 601-6016.

[3] CHANG, J. D.; YU, S. S.; CHEN, H. H.; TSAI, C. S. (2010). HSV-based color texture image classification using wavelet transform and motif patterns. Journal of Computers, v. 20, n. 4, p. 63–69.

[4] NEVES, M. N.; JÚNIOR O. R. N.; LUIZ. A. J. B. ; SANCHES, I. D. (2017). Índice de cobertura verde para imagens de altíssima resolução. Anais do XVIII Simpósio Brasileiro de Sensoriamento Remoto – SBSR 28 a 31 de Maio de 2017. INPE Santos - SP, Brasil. ISBN: 978-85-17-00088-1

[5] MEIER, L. PIXHAWK. (2018).Computer vision and geometry lab. Disponível em: <https://pixhawk.org/>. Acesso em: 16 maio. 2018.

[6] MARTIN,K.L;MALZER,G.L;MULLA,D.J;HUGGINS,D.R;STROCK, J. (2003) Spatial and Temporal Variation in Economically Optimum Nitrogen Rate for Corn. Agronomy Journal, Madison, v. 95, n. 4 , p. 958-964.

[7] MELO, A.C.G.; REIS, C.M.; RESENDE, R.U (2010). Guia para Monitoramento de Reflorestamentos para Restauração. Circular Técnica 1 Projetos Mata Ciliar, São Paulo: Secretaria de Meio Ambiente, n. 1, 10 p.

[8] RAMOS, J. J. G.; BUENO S. S. (2007) Uma proposta para uma rede de ensino, pesquisa e desenvolvimento em veículos robóticos aéreos. In: Simpósio Brasileiro de Automação Inteligente (SBAI), 8., Florianópolis, SC.Anais. Campinas: SBA, 2007. Disponível em: <http://www.sba.org.br/rsv/SBAI/SBAI2007/docs/30907_1.pdf>. Acesso em: 16 maio. 2018.

[9] TEAL,R.K;TUBANA,B.;GIRMA,K.;FREAMAN,K.W.;ARNALL,D.B;WALSH,O.;RAUN, W.R. (2008). In-Season Prediction of Corn Grain Yield Potential Using Normalized Difference Vegetation Index. Adronomy Journal, Madison, v.98, n6, p. 1488-1494.