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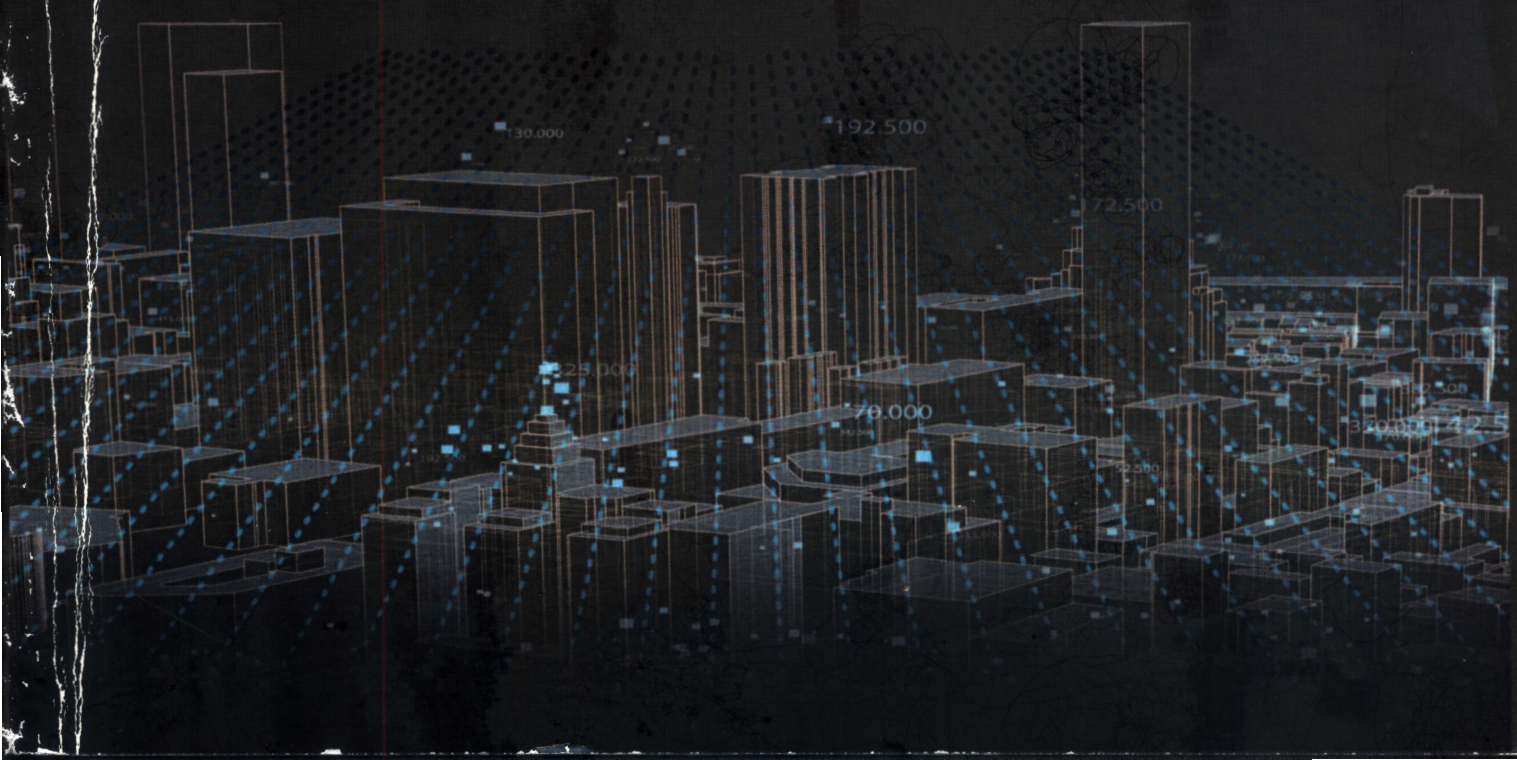
# PROPERTY TALK 2021

## INDUSTRIAL REVOLUTION 4.0 IN MALAYSIAN PROPERTY



# PROPERTY TALK 2021: INDUSTRIAL REVOLUTION 4.0 IN MALAYSIA PROPERTY

**HOUSING AND LOCAL GOVERNMENT TRAINING INSTITUTE**
**UNIVERSITI TEKNOLOGI MARA, PERAK BRANCH**
**November 2021**

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**ISBN 978-967-25697-7-0**

9 7 8 9 6 7 2 5 6 9 7 7 0

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# DETERMINATION OF TREE HEIGHT BASED ON TREE CROWN USING ALGORITHM DERIVED FROM UAV IMAGERY

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## Abstract

A single tree crown extraction is of great importance for forest management and inventory. In this study, an automated segmentation method that is able to fully utilize the unmanned aerial vehicle (UAV) data for extracting, and characterizing a single tree crowns with many geometric and topological properties. UAV becomes one of the appearance technologies that offers an affordable, cheaper, and faster technology in acquiring data for numerous applications. This technology had provided the ability to clearly look at a single tree, which shows opportunities in many activities such as monitoring, tree species mapping and tree disease mapping. In this study, UAV technology has been taking a look at several algorithms for estimating tree height value of a single tree crown. The single tree crown was obtained from the digital surface model by using four algorithms such as watershed segmentation, object-based image analysis, inverse watershed segmentation and seed generation. As a conclusion, this study has contributed to the knowledge extension in this area and presented the result of the tree height values according to the segmentation algorithm at the different flying height data.

**Keywords:** UAV Imagery, Tree Height Estimation, Tree Crown Extraction

## 1.0 INTRODUCTION

The forest information such as tree height, crown diameter, tree count is essential for several applications like forest regeneration, biodiversity assessment, tree growth modelling and others (Biging & Gong, 2007; Iizuka et al., 2018; Mohan et al., 2017; Jaafar et al., 2018). Those parameters are important in order to sustain the better planning and monitoring of the forest values and its existence in our global environment. Therefore, the forest information is critical for the effective analysis and management of forest. However, gathering faster and more efficient of forest inventory information is presently become one of the concerns and challenges in forest management (Iizuka et al., 2018).

## 2.0 LITERATURE REVIEW

### 2.1 Unmanned Aerial Vehicle

UAV becomes an advanced technology with more cost-effective to airborne LiDAR and RADAR technologies (Mweresa et al., 2017), controllable, achievable to obtain the high resolution (Seul et al., 2015) and produce 3D images in data processing (Tuominen et al., 2015). Furthermore, UAV imagery, presently, has been used to systematically observe forest canopy height (Panagiotidis et al., 2017).

### 2.2 Tree Height Estimation

Tree height is an important ecological attribute, to determine the trees flourish with sunlight. Otherwise, the tree becomes die because of no sun exposure. There some studies were conducted to estimate the tree height for a particular purpose such as estimation of forest biomass, forest assessment of planning and design (Ritter, 2014), 3D model of forest structure (Iizuka et al., 2018) and model the forest canopy surface (Lisein et al., 2013). Mweresa et al., (2017) estimate tree height using the basic calculation technique which is subtracting Digital Terrain Model (DTM) from DSM. In this study, the estimation of tree height will be based on tree crown delineation derived from DSM. In this case, four (4) appropriate algorithms are used to extract tree crown.

## 3.0 RESEARCH METHODOLOGY

The data acquisition and processing were conducted using quantitative method. It involves four phases which include preliminary study, data acquisition, data processing, and results and discussions as shown in Figure 1. In this study, a single tree canopy was used to conduct the data acquisition process. Phase 1 is on the preliminary study that deals with determining study area and flight planning. Phase 2 addresses the data acquisition by using DJI Phantom 4 pro to capture oil palm tree. Phase 3 discusses on data processing. Finally, phase 4 presents the results and data interpretations.

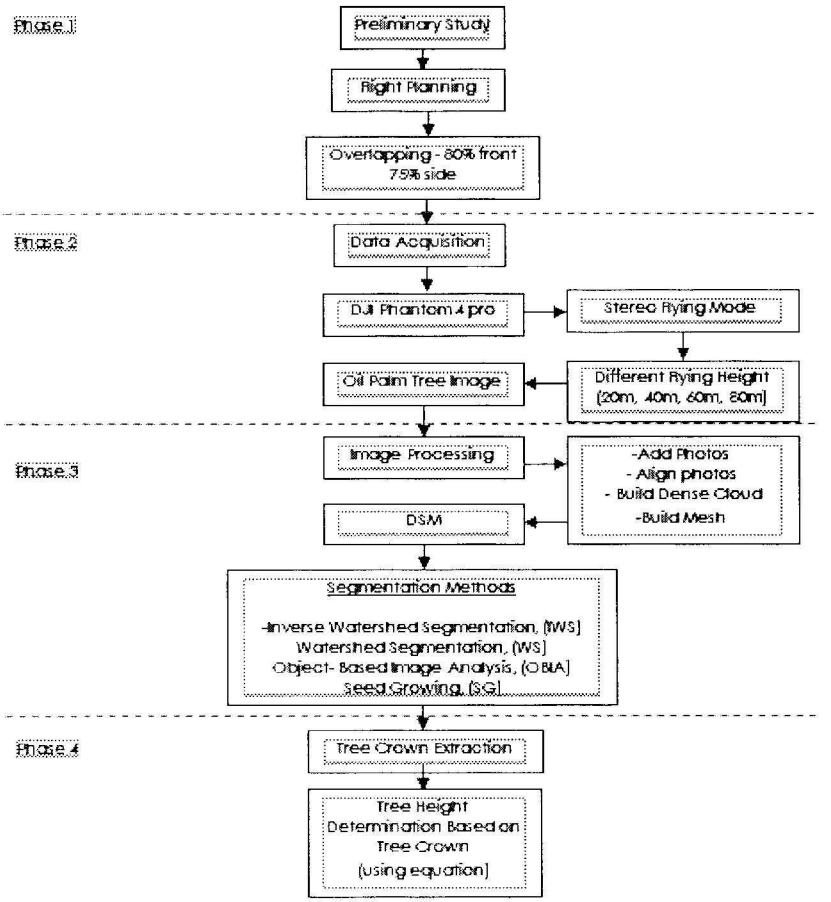


**Figure 1: Overall Methodology Process.**

The study focuses on a single oil palm tree as a case study. It is located at (4°22'50.60" N, 101°01'00.24" E) Kg Bali area within the region of private oil palm plantation. In this study, a single tree canopy was used to conduct the data acquisition process. A single tree canopy was selected to see the effectiveness of tree crown based on algorithms approach to determine tree height value in different flying height.

A single tree canopy was selected to see the effectiveness of tree crown based on algorithms approach to determine tree height value in different flying height. The UAV was flown at an altitude 20 meters, 40 meters, 60 meters and 80 meters with an image overlapping 80% front lap and 75% side lap. The image was captured in stereo mode flying view for each flying altitude. After having the data acquisition, all the acquired raw images data were

processed using Agisoft Photoscan software. All the processes were performed under the requirement settings and in a fully automated approach. At this stage, there are five processes to be accomplished (see Figure 2). Firstly, aligning photos which is to find the orientation for each photo and camera position was set based on onboard positioning. With regard to this, the selection of the accuracy level is based on four scaling rates, namely the highest, high, medium, and low processes. It is followed by the process of building dense cloud which is to perform the image matching automatically. In this situation, the algorithm used to search the same point for each image before proceeding to the 3D generation. The next process is to

build mesh which is to create the surface by using triangulation method. Finally, is to generate a digital surface model (DSM) where through it the tree crown can be extracted accordingly.

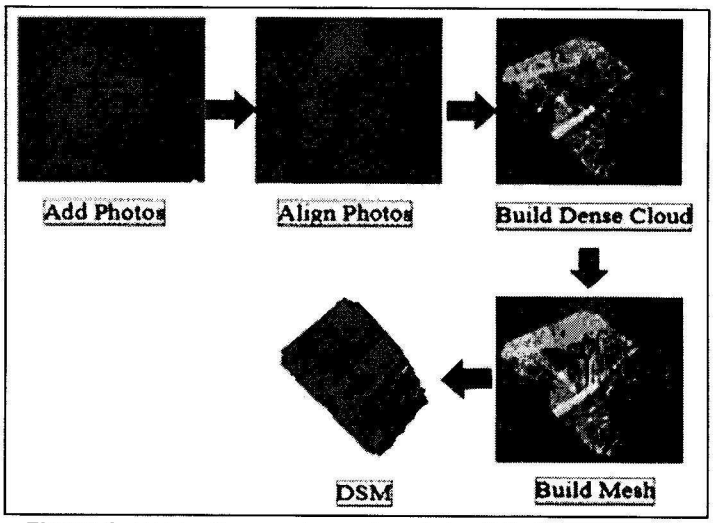


**Figure 2: Image Processing using Agisoft Software.**

## 4.0 RESULTS AND DISCUSSION

By accomplishing all the processes that have been explained above, Figure 3 shows the tree crown extraction results by segmentations methods and flying height.

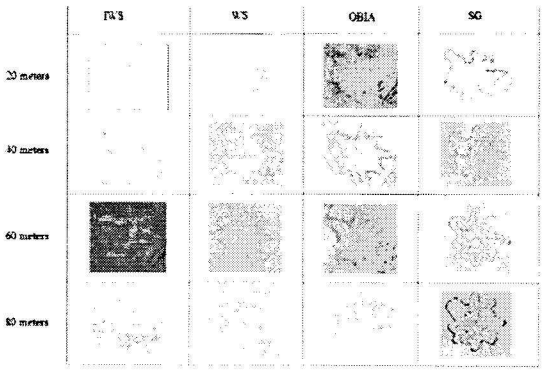


**Figure 3: Tree Crown Results by Algorithm Approaches and Flying Height.**

Table 1 shows the tree crown diameter reading according to the different segmentation algorithms and the different flying heights. From the results, it has found that the crown diameter value is less than 1 meter for all the segmentation heights. The crown diameter values from OBIA are slightly different which given range of 0.073m to 0.525m at different flying height. However, the crown diameter values for SG segmentation produced between 0.002m to 0.016m reading at different flying altitude. The reading value for IWS segmentation indicates that different crown diameter between 0.023m to 0.923m at different flying height. Meanwhile, the WS segmentation presented the crown diameter between 0.058m to 0.892m.

**Table 1: Crown Diameter Values.**

| Flying Height (m) | Tree Crown Diameter (meter) | | | |
|---|---|---|---|---|
| | IWS | WS | OBIA | SG |
| 20 | 8.037 | 8.912 | 8.321 | 9.473 |
| 40 | 8.960 | 9.746 | 8.561 | 9.471 |
| 60 | 8.937 | 9.048 | 8.634 | 9.457 |
| 80 | 8.301 | 8.854 | 8.846 | 9.473 |

As indicates in Table 2, the IWS algorithm has recorded a different reading between 0.025m to 1.019m at different flying height. The WS algorithm has recorded a different between 0.064m to 0.921m tree height value at different flying height. For OBIA algorithm, the tree height values are recorded of 0.081m to 0.580m at different flying height. Finally, the values of 0.001m to 0.017m is recorded for SG algorithm at different flying height. As a critical summary for the findings, each algorithm has of its ability to provide acceptable values for the tree crown diameter and the tree height. In this case, the algorithm with a higher consistency in the generating value to be considered as the most appropriate than others. Therefore, among the four, it has found that the SG segmentation method becomes the most appropriate method due to having a higher consistency values both measurements. However, other segmentation methods have also provided consistent results, but the values are greater than the SG segmentation method.

**Table 2: Tree Height Values at Different Flying Height.**

| Flying Height (m) | Tree Height (meter) | | | |
|---|---|---|---|---|
| | IWS | WS | OBIA | SG |
| 20 | 8.877 | 9.843 | 9.190 | 10.462 |
| 40 | 9.896 | 10.764 | 9.455 | 10.461 |
| 60 | 9.871 | 9.994 | 9.536 | 10.445 |
| 80 | 9.168 | 9.779 | 9.770 | 10.462 |

## 5.0 CONCLUSION

As a conclusion. this study has discovered the ability of the UAV technology in estimating the tree crown and tree height as required information in the multiple fields and future research applications regarding this forestry area. Therefore, the application of the four segmentation methods as testing works is appropriate thus shall contribute to the literature enlightened of both the UAV and forest as well as agricultural development. However, many things are needed to be done to make this exploration becomes more valuable and acceptable. This will further discuss in another paper. Worthy to note, at this stage, this study has brought the UAV technology to the upfront success in this era, standing with other popular technologies such as LiDAR and Radar in photogrammetry production. However, this study is only at a simulation stage, where only a single tree as the parameter of measurements. Indeed, this exploration is still progressing to cover a cluster of tree canopy area.

## REFERENCES

Biging, G. S., & Gong, Æ. P. (2007). Detection of Individual Trees and Estimation of Tree Height using LiDAR Data, (September 2015). https://doi.org/10.1007/s10310-007-0041- 9

Iizuka, K., Yonehara, T., Itoh, M., & Kosugi, Y. (2018). Estimating Tree Height and Diameter at Breast Height (DBH) from Digital Surface Models and Orthophotos Obtained with an Unmanned Aerial System for a Japanese Cypress. *Remote Sensing*, *10*(1). https://doi.org/10.3390/rs10010013

Jaafar, W. M. W. S., Woodhouse, I. H., Silva, C. A., Omar, H., Maulud, A. K. N., Hudak, A. T.,

... Mohan, M. (2018). Improving Individual Tree Crown Delineation and Attributes Estimation of Tropical Forests Using Airborne LiDAR Data. *Journal of Forests*, *9*(12), 1– 23. https://doi.org/10.3390/f9120759

Lisein, J., Pierrot-Deseilligny, M., Bonnet, S., & Lejeune, P. (2013). A Photogrammetric Workflow For The Creation of A Forest Canopy Height Model From Small Unmanned Aerial System Imagery. *Forests*, *4*(4), 922–944. https://doi.org/10.3390/f4040922

Mohan, M., Silva, C. A., Klauberg, C., Jat, P., Cardil, A., Hudak, A. T., & Dia, M. (2017). Individual Tree Detection from Unmanned Aerial Vehicle (UAV) Derived Canopy Height Model in an Open Canopy Mixed Conifer Forest. *Forests*, *8*(9), 18. https://doi.org/10.3390/f8090340

Mweresa, I. A., Odera, P. A., Kuria, D. N., & Kenduiywo, B. K. (2017). Estimation of Tree Distribution and Canopy Heights in Ifakara , Tanzania Using Unmanned Aerial System ( UAS ) Stereo Imagery. *American Journal of Geographic Information System*, *6*(5), 187–200. https://doi.org/10.5923/j.ajgis.20170605.03

Panagiotidis, D., Abdollahnejad, A., Surový, P., & Chiteculo, V. (2017). Determining Tree Height and Crown Diameter from High-Resolution UAV Imagery. *International Journal of Remote Sensing*, *38*(8–10), 2392–2410. https://doi.org/10.1080/01431161.2016.1264028

Ritter, B. (2014). Use of Unmanned Aerial Vehicles (UAV) for Urban Tree Inventories.

Seul, L. Y., Hien, L. P., Soo, P. J., Hee, L. M., Wook, P. M., In, K. J. (2015). Calculation of Tree Height and Canopy Crown from Drone Images Using Segmentation. *Journal of the Korean Society of Surveying Geodesy Photogrammetry and Cartography*, *33*, *No. 6*, 605–613. https://doi.org/10.7848/ksgpc.2015.33.6.605

Tuominen, S., Balazs, A., Saari, H., Pölönen, I., Sarkeala, J., & Viitala, R. (2015). Unmanned Aerial System Imagery and Photogrammetric Canopy Height Data In Area-Based Estimation of Forest Variables. *Silva Fennica*, *49*(5), 19. https://doi.org/10.14214/sf.1348 {Bibliography

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Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

**"BERKHIDMAT UNTUK NEGARA"**

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**SITI BASRIYAH SHAIK BAHARUDIN**
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Setuju.

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