Image based modeling for oil palm fruit maturity prediction

Abstract

This paper describes the validation process on the relationship of the oil content quantity for mesocarp oil palm fruits with the digital value for its colour surface. The procedure starts from collection of the fruitlets of fresh fruit bunches (FFB) during unripe (black color surface) until overripe (orange color surface) stage. The ages of oil palm trees chosen in this experiment were of 5, 16 and 20 years old at Malaysian Palm Oil Board (MPOB) Research Station, Bangi Lama, Malaysia. The variety of oil palm is Tenera (Elaeis giaineensis). Nikon coolpix4500 digital camera with tele converter zooming and the Keyence machine vision were used to capture the FFB images in the oil palm plantation. The images were analysed for optical properties of color, namely hue, using the developed analysis software and then compared with the value from Keyence machine vision. The images were only captured at monitored area of FFB and the camera parameters (namely shuttle speed, image sensor's sensitivity (ISO) and white balance) were controlled. The lighting intensity under oil palm canopy was simultaneously recorded and monitored using Extech Light Meter Datalogger. On the same day, the fruitlets were plucked from FFB and analysed for oil mesocarp content by using the Soxhlet extractor machine. The calculations to determine the mesocarp oil content was developed based on ratio of oil to dry mesocarp. The Minolta MPOB colorimeter was used to validate and compare the ripeness criteria. Regression analysis of polynomial 2nd order method showed that the optical property of oil palm fruit was significant in determining the oil from the mesocarp fruit, respect to the degree of maturity, with regression equation $y = -0.0116x^2 + 5.2376x — 514.88$ and $R^2 = 0.884$, where y is mesocarp oil content, x is hue value and R2 is coefficient of determination, respectively. The triangulation method was used for estimating the optimum days for harvesting the FFB at the highest content and quality of the oil. For validation process, high correlation of hue digital value was found between the developed systems using Nikon digital camera and the Keyence vision with $y = 0.9063x+21.371$ and $R^2 = 0.929$ with average percentage differences of 2.6%, respectively. Hence the first task to ensure quality in oil palm milling is to select a good quality FFB for processing which means that only right mature fruit should be harvested, so this study introduced the new concept of image based measurement for modelling the oil palm FFB maturity prediction which enables to determine the correct time for harvesting.