

Étude photogrammétrique de l'infrarouge thermique par drone : intérêt pour l'agriculture de précision en Afrique sahélienne

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Leaf surface temperature is a reliable indicator for determining water stress and therefore it can be used to identify the varieties that are best adapted to this thermal constraint. Within the framework of the GLDC funding from the CGIAR, CERAAS seeks to develop a method of high-throughput phenotyping of the temperature of the plant canopy by using images obtained by a thermographic camera on board a drone. For reasons of weight and miniaturization, the thermographic cameras that can be mounted on a drone are not cooled and do not give directly usable values. The first objective of the work carried out in Thiès (Senegal) was to set up an automated pipeline for processing thermographic images on Python and R using photogrammetric techniques to obtain ortho-images and classification by thresholding to eliminate non-vegetation elements. In a second step, the data were calibrated through machine learning algorithms using known thermal references placed on the ground.
For this calibration, we used four reference mats with known temperature and performed simple linear regression models. The results obtained show that the model allows a good estimation of the temperature (r2 = 0.96) with a root mean square error of 3.22 °C. These calibration results were validated on other trials in different environments (Bambey, Senegal). The validation resulted in a model with an r2 = 0.89 and a root mean square error of 4.48 °C. This calibration and the thermographic image processing pipeline were then used for a practical agronomic application on a varietal trial of sorghum response to water deficit conducted in Bambey. The results show that plants in the non-irrigated treatment had an average canopy temperature 5°C higher than the canopy temperature of plants in the irrigated treatment. These differences in canopy temperature are similar to those reported in the literature.
On the other hand, the population used shows a genetic diversity of canopy temperature under water deficit conditions that can be used in breeding programs. This technique of acquisition and processing of thermographic images is of great interest for research activities in varietal selection but also in agroforestry and agroecology. It allows us to study the behavior of the crop at the scale of the plot or even the landscape. It is a perfect diagnostic tool for farmers' surveys to evaluate the diversity of situations and to identify innovative agronomic techniques for managing crop water deficit.

Keywords: Drone, Photogrammetry, Agriculture, Canopy temperature, Image processing.

Biography

I am a topographic surveyor engineer. I am currently doing my doctorate in remote sensing at the Centre de coopération internationale en recherche agronomique pour le développement. I also won the best poster award at the international conference on sustainable intensification in 2021.

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