Identification of Corn Lodging Using U-Net Semantic Segmentation

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Abstract

Corn yield is dependent on factors such as plant density, presence of water and nutrients, temperature, and type of crop variety. The lagging effect of these factors can either impede or improve upon crop yield at harvest. Prediction of corn yield from technological-aided approach assists farmers to make decision on adopting measures that could improve yield to feed the increasing human population, livestock that rely solely on corn and for scientific purposes. However, reduction in crop yield is attributed to small, moderate, or severe lodging of plant roots, stems which shortens plant height and impact corn yield. Lodging results in the plant leaning towards the earth due to the occurrence of strong wind and rainstorms. Identification of lodged plants from crop imagery and data-driven analysis provide cost-effective time sensitive information to the stakeholder to decide the best cultivation recovery mechanism such as increasing corn seed per hole before the end of the corn season. The study area was divided into three blocks with different treatments. There was no prescribed burning in the first two blocks while the control plot was burned following a prescribed plan. A UAV with the mounted RGB and NIR sensors was flown over the study area; (1) the first block was not burned, and fertilizer was applied, (2) the second block was not burned and no fertilization, (3) the control block was burned, and fertilization applied from planting to harvesting biweekly to capture the field remotely. The remote sensing images were processed and the digital elevation model (DEM) and orthoimages of the area were created. Plant height was determined from DEM and Normalized Difference Vegetation Index (NDVI) was estimated using the orthoimages for crop growth and yield analysis. U-Net architecture was used in this study for lodged and non-lodged plants image segmentation considering the changes of crop heights and NDVI extracted from the multi-temporal UAV captured from the time of planting (April) to harvesting (August).

Keywords: Lodging, UAV, Deep learning, Sensor, Orthoimage, Precision agriculture, Vegetation indices

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