Deep learning sensor fusion in plant water stress assessment: a comprehensive review

ABSTRACT

Water stress is one of the major challenges to food security, causing a significant economic loss for the nation as well for growers. Accurate assessment of water stress will enhance agricultural productivity through optimization of plant water usage, maximizing plant breeding strategies, and preventing forest wildfire for better ecosystem management. Recent advancements in sensor technologies have enabled high-throughput, non-contact, and cost-efficient plant water stress assessment through intelligence system modeling. The advanced deep learning sensor fusion technique has been reported to improve the performance of the machine learning application for processing the collected sensory data. This paper extensively reviews the state-of-the-art methods for plant water stress assessment that utilized the deep learning sensor fusion approach in their application, together with future prospects and challenges of the application domain. Notably, 37 deep learning solutions fell under six main areas, namely soil moisture estimation, soil water modelling, evapotranspiration estimation, evapotranspiration forecasting, plant water status estimation and plant water stress identification. Basically, there are eight deep learning solutions compiled for the 3D-dimensional data and plant varieties challenge, including unbalanced data that occurred due to isohydric plants, and the effect of variations that occur within the same species but cultivated from different locations.

Keyword: Artificial intelligence; Agriculture monitoring system; Modelling; Plant-based water stress; Smart sensor