

Integration of dual band radio waves and ensemble-based approach for rice moisture content determination and localisation

Abstract

Maintaining optimal moisture content in grain storage is critical to ensuring adequate supply throughout the year, but it presents a significant challenge. Current moisture measurement methods often necessitate sophisticated and costly equipment. This paper introduces an approach employing real-time rice moisture content determination and detection of spoilage (specifically wet spots) within a storage facility achieved through the utilisation of radio waves operating at 2.4 GHz and 868 MHz, along with an ensemble-based machine learning algorithm. Experimental samples spanning from 12% to 30% moisture levels were collected, then subjected to pre-processing, and subsequently employed to train the Ensemble-based Rice Moisture Content and Localisation (eRMCL) algorithm. The eRMCL produced an effective prediction of both rice moisture content and the localisation of wet spots within the grain storage unit. The results show that compared to support vector machine, random forest, and machine learning methods, the eRMCL algorithm had the best performance metrics, with an accuracy of 94.8% in predicting the moisture content and location of spoilage in storage. The measurement of moisture content and the identification of wet spots in rice storage using the dual frequency wave approach were found to be more accurate than with a single frequency band. Thus, the dual frequency band is a novel method for the determination of the moisture content of stored rice and the localisation of the spoilage area.

Keywords

Artificial intelligence; Electromagnetic wave absorption; Ensemble technique; Machine learning