


Chapter 11


Quantum Fields of Vision UAV–Driven Rice Growth Stage Mapping With Quantum– Inspired Algorithms

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ABSTRACT

Food safety and precision farming need accurate plot-scale rice yield predictions, so we developed a method combining UAV-derived vegetation indices (VIs) with brightness, greenness and moisture data from tasseled cap transformation (TCT). Eight nitrogen gradients of rice were used during the booting and heading stages to obtain ground truth and six-band UAV imagery. We propose a hybrid quantum learning model that uses Bi-LSTM for extracting temporal features and quantum

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circuits for quantum feature processing. These enhanced features are combined with Bi-LSTM outputs into an XGBoost regressor. Our Quantum BiLSTM + XGBoost approach outperformed traditional models by 7-10%, achieving ~94% accuracy.

INTRODUCTION

Due to shorter operating times and increasingly technologically superior planes, the aviation sector is currently experiencing significant growth. Many things are coinciding, and this is the result. As a result, maintenance activities are under increased scrutiny and must now be more precise, economical, and efficient without sacrificing safety or compliance with regulations (Cahyana et al., 2024). As a result, the amount of stress emanating from this has significantly increased. While looking at planes by hand and testing them with fixed equipment are reliable ways to evaluate them, they do have many limitations. Both visual and manual inspections are possible on airplanes (Chen et al., 2022). Factors such as weather, light levels, and accessibility might impose significant constraints on the amount of time and effort needed to do these tasks. These constraints have accelerated the transition to inspection systems utilizing autonomous drones. These systems have the potential to be more precise, applicable in more contexts, and substantially less labor-intensive for humans.

Rice is a staple food that feeds approximately half the world's population (Chen et al., 2024). It accounts for more than 21% of the calories consumed by humans worldwide and plays an essential role in maintaining food security and promoting community well-being. Thus, to aid in agricultural strategic planning and decision-making, rice production forecasts are crucial. Allocating resources optimally, maintaining price stability, and guaranteeing food availability all depend on this mechanism (Daniel et al., 2022). The ability to accurately predict future events enables stakeholders and policymakers to manage storage more effectively, respond to changes or emergencies, and anticipate production demands and market demand dynamics (Das et al., 2024). When making predictions about rice yields, it is crucial to consider a broad range of variables, including weather, temperature, pesticide use, and the impact of global warming (de Groot et al., 2025). Figure 1 shows a Quantum-Inspired Hybrid Workflow for Rice Yield Prediction.

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