Artificial Intelligence Methods for Seed Quality Inspection

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Introduction

As the world population increasing, the demand for agricultural products is rising rapidly to fulfil this demand quality seed is one of our major requirements as every year, people from farming communities worldwide decide the type of crop to plant in their fields to produce a higher yield. The crop seeds chosen are the biggest factor for the farmers. Therefore, it is of great significance to strengthen seed quality testing during seeds planting, producing, processing, transportation and selling. Crop seed quality inspection includes seed purity, viability, moisture and lipid content, seed vigor measurement, etc.

Conventional methods of inspecting artificial seed quality involve a manual comparison of seeds based on many factors such as size, shape, degree of desiccation, color variation following chemical treatment, hollow ratio, and more details. These approaches are labor-intensive and ineffective, and they cannot keep up with the demands of contemporary agricultural development. Increasing grain output and agricultural development present a scientific challenge when it comes to using modern science and technology for seed quality control. In recent times, scientific advancements have led to a rapid development of crop seed quality inspection equipment and technologies. As a result, the technique for quality inspection that combines artificial intelligence with spectral image processing arises, improving the automation and intelligence of agricultural product quality inspection.

With the benefits of simple operation, quick and non-destructive inspection, and simultaneous multi-component analysis, spectral analysis technology is used extensively for material composition measurement and identification, chemical analysis, and other related applications. It yields the spectral characteristic information of the tested object. By combining spectrum analysis and image analysis technologies, spectral imaging technology produces a three-dimensional data cube with spectral and picture information about the object being detected instantly. Hyperspectral imaging provides more information than multispectral imaging, which has sparked a lot of interest in a variety of industries, including agriculture and medical. It is frequently used in farm soil monitoring, crop growth assessment, and crop yield estimation, particularly in the field of fine agriculture.

Application

- **Purity test of seeds:** It is inevitable that the seeds will be mixed with other seeds or other impurities such as gravel during harvest. Rapid seed quality identification is beneficial to improve seed purity, ensure crop phenotypic consistency and crop yield. Different varieties of rice have different reflectivity intensity, so the hyperspectral samples of rice with different adulteration degree are separable and suitable for modeling. mixed two kinds of rice according to 5 proportions, and obtained spectral images of 200 rice samples by using hyperspectral imaging system. *Sun et al*.
- **Test for moisture and lipid content of seeds:** Water content is an important factor in evaluating seed quality and storage status. Too high-water content of rice will affect the taste of rice, and is not conducive to processing, storage and transportation, and easy to mildew. To detect the water content of brown rice, *Heman et al*. used multiple linear regression (MLR) and partial least squares regression (PLSR) to model the visible/near-infrared spectrum of brown rice, respectively.
- **Vitality test of seeds:** Seed vigor refers to the ability of seed to arch the soil and sprout. The seed with high vigor can withstand storage and has obvious growth advantage, which is of great economic significance to increase agricultural production. *Li et al*. first studied the selection of hyperspectral characteristic bands of sweet corn by using FIPLS (Forward

interval Partial Least Square), CARS and UVE (Uninformative Variable Elimination) variable screening method, and proposed a fast-screening method for high-vigor corn seeds. The near infrared diffuse reflectance spectra of sweet corn seeds aged by stages at high temperature were collected by this method, and quantitative models of germination rate, germination index and vigor index were established by partial least square regression (PLSR).

Conclusions

The use of artificial intelligence techniques that combine data analysis and spectral image processing has significantly improved seed quality control. It offers the benefits of non-destructive, quick, and real-time online detection, and it has a lot of promise for modernizing agriculture. This report makes the following predictions based on the state of research on the use of spectral imaging and image processing technologies in seed quality inspection:

1) Increase the effectiveness of the picture denoising and segmentation method, shorten the algorithm's execution time, and produce high-accuracy segmentation images;

2) In order to maximize data processing efficiency for spectral information mass data, it is critical to use the best dimension reduction technique to minimize processing time while maintaining information integrity;

3) A range of seeds could be chosen for an investigation of seed quality in order to increase the detection model's stability and transmission;

4) In terms of identifying seed vigor, consideration should be given to classifying seed vigor. Additionally, in order to assess the vigor level of seeds, our team plans to create a relationship model between seed vigor and bud length and root length by measuring the bud length and root length of seed germination photos using spectral technology in conjunction with image processing.

References

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