Gas Leakage Detection with Hyperspectral Imagery-Based Vegetation Stress Indices.

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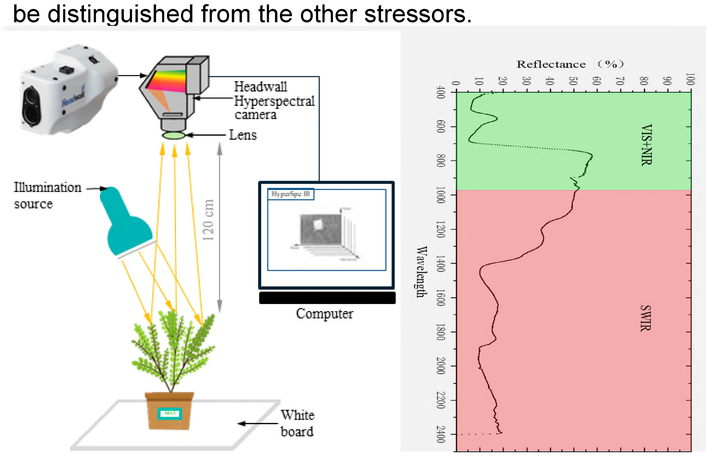
INTRODUCTION

the objective of this research is to provide a basis for gas leakage detection with hyperspectral cameras. The gas leakage attacks vegetations, which yields some spectral signature changes. As the vegetation under different stressors may induce similar effect. The spectral signature changes can be similar. A lab test was arranged to test three kinds of plants under four common natural stressors with a reference. All plants are routinely scanned with hyperspectral cameras every three days to obtain every developmental stage. Linear discriminant analysis (LDR) was applied in the data analysis to discriminate the plant with gas leakage treatment from the other stressors. The result shows that there is a more than 80 percent possibility that gas leakage can be distinguished from the other stressors.

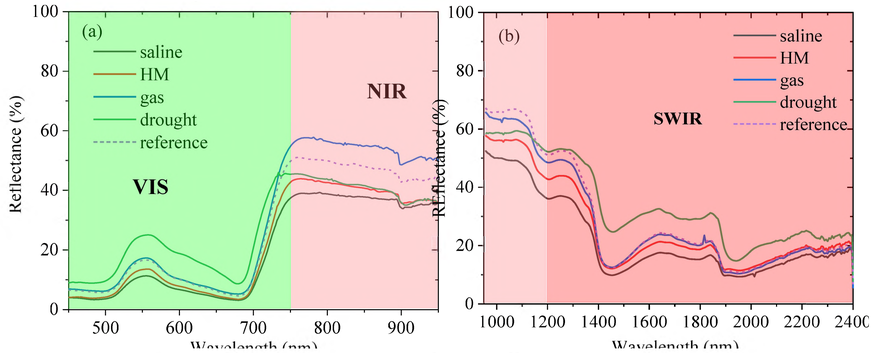


METHODS

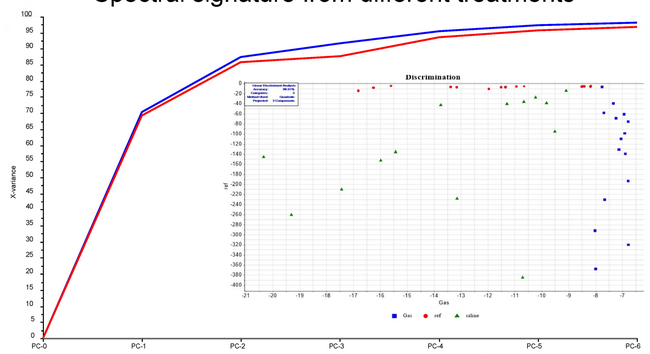
A greenhouse test was introduced to cultivate plants under a stable environment. Plants are treated with four stressors after 15 days acclimation duration. The stressors are salinity, water deficit, and heavy mental contaminated soil. A reference without any treatment is set up. Salinity is simulated by supplying additional mixed salt solution to the soil until the electrical conductance reached the preset level (10ds/m). Likewise, the heavy metal contaminated soil is guaranteed by adding several heavy metal salt whose amount was referred to UGSS. As for water deficit simulation, only 1/5 water was fed to plant compared with the normal. All plants were cultivated for 4 months to ensure plant git stressed by each stressors unless it was dead due to the treatment.

RESULTS

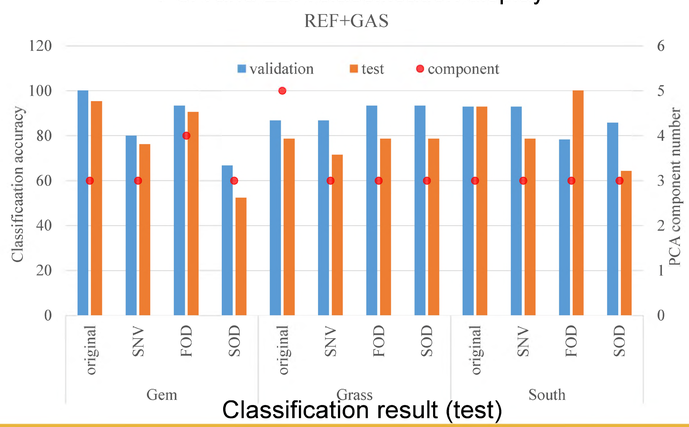
The spectral signatures obtained from plant under various stressors exhibited difference though not always remarkable. the exact changes are listed in the table. LDR mode employed the principal component analysis (PCA) to reduce dimension of the dataset to facilitate the discrimination. PCA reduced the data dimensions with 5 generally. And the PLD method can discriminate each stressors with an acceptable accuracy, which reaches 80 percent.



Spectral signature from different treatments



PCA and LDA classification display



Classification result (test)

CONCLUSIONS

- LDA successfully tells apart the stressed plant with the spectral signature information.
- The discrimination of gas treatment plant from the other four stressors is not favorable. LDA model to classify five treatment simultaneously is not a good choice cause the accuracy is not high.
- Gas treatment can be discriminated from the other stressors with high classification accuracy.
- Different section of spectral signature selection greatly influences the gas treatment classification. The combination of VIS+NIR yields the best classification result in all cases.
- Transformation of the original data also exerts impact om the discrimination accuracy. FOD achieves the best result.
- Among stressors combinations, saline+gas+ref can not be effectively classified.

REFERENCE

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