4th World Congress and Expo on Nanotechnology and Materials Science

國立中正大學 National Chung Cheng University

# AUTOMATIC TARGET RECOGNITION OF AIR POLLUTION DETECTION BY HYPERSPECTRAL IMAGING

Kai-Chun Li[1,2], Wen-Nung Lie[3], Wei-Min Liu[4], You-Fu Zhang[5],
Chin-Long Liao[5], and Hsiang-Chen Wang[1,2]

[1]Graduate Institute of Opto-Mechatronics, National Chung Cheng University, Taiwan.
[2]Advanced Institute for Manufacturing with High-tech Innovations (AIM-HI), National Chung Cheng University, Taiwan.
[3]Department of Electrical Engineering, National Chung Cheng University, Taiwan.
[4]Department of Computer Science and Information Engineering, National Chung Cheng University, Taiwan.
[5]Research Division of Materials and Electro-Optic, National Chung-Shan Institute of Science and Technology, Taiwan

## Abstract

Different from the past designs of ATR typically forming a single band (for example, near or far-infrared wavelength) of information to determine the target, but the use a multi-SPECTRAL images or hyperspectral imaging wealth of information for target recognition, not only in satellites, medicine, plants and animals. The purpose of this research is to establish a set image library that are suitable for analysis of different target characteristics by hyperspectral imaging repository, and the development of target detection and identification of multi-spectral algorithm library of investigator for building the appropriate ATR law[1]. Based on hyperspectral imaging, using Multiple regression analysis to calculate the PM2.5 and PM10 concentration from the pervious result.

## Experimental simulation results

This experiment establishes three bands of hyper-spectral image algorithms , and then use camera instruments with different response bands to set up the algorithm module in Fig.1 ~ 3 . The image is subjected to hyperspectral to calculate the spectral information of each pixel in the image, and then a specific target is selected for spectrum analysis as shown in Fig.4 .

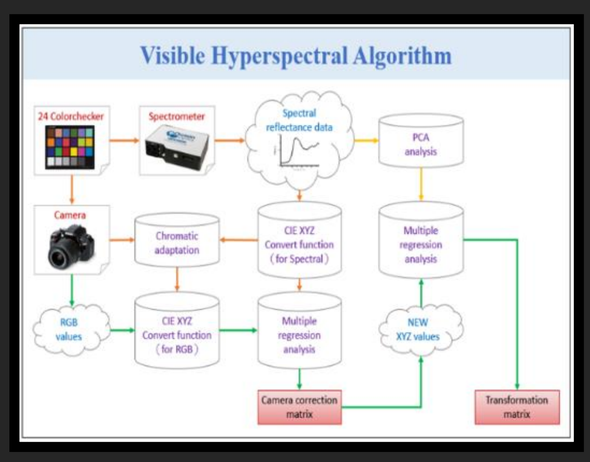


Fig. 1 Visible light hyperspectral algorithm flow

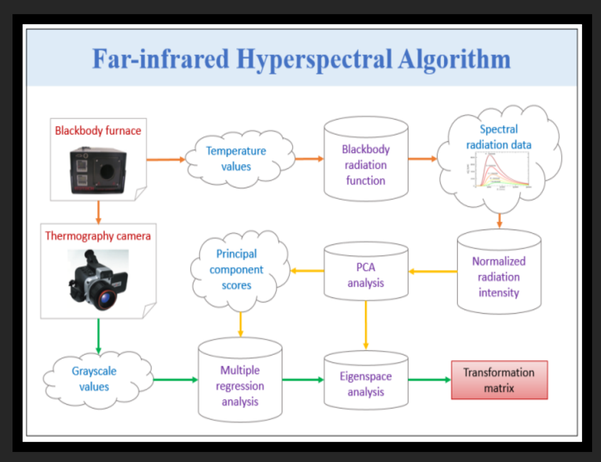


Fig. 2 Near-infrared hyperspectral algorithm flow

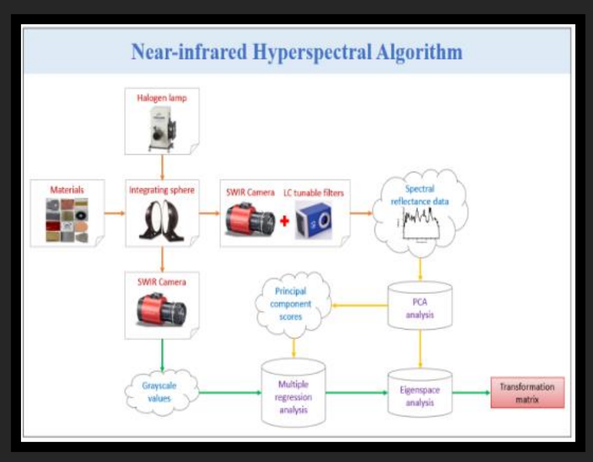


Fig. 3 Far-infrared hyperspectral algorithm flow

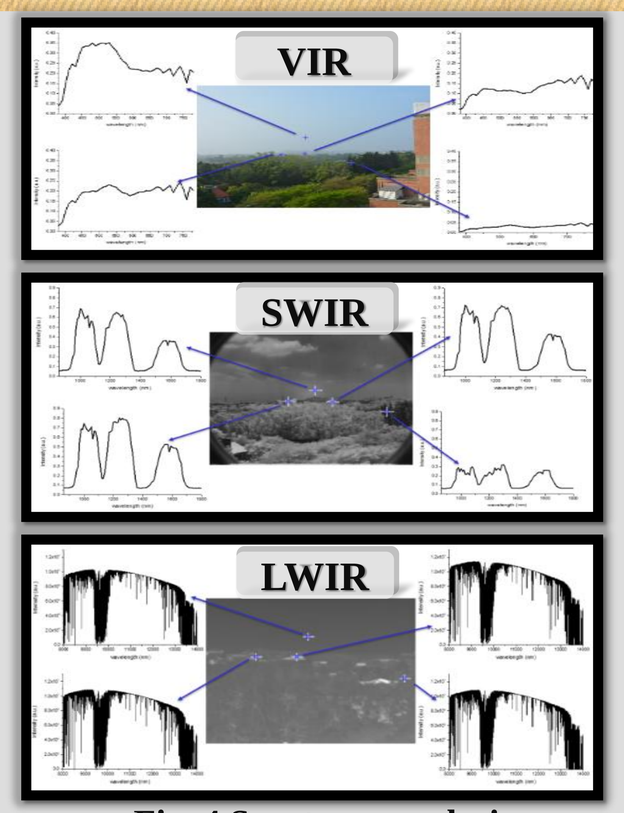


**Fig. 4 Spectrum analysis**

## RESULTS AND DISCUSSION

From the results of the in Fig.5,The spectral data normalized by the brightness for integration , and the data of the measurement station are subjected to regression analysis to obtain the extinction coefficient(E) of PM2.5 and PM10.

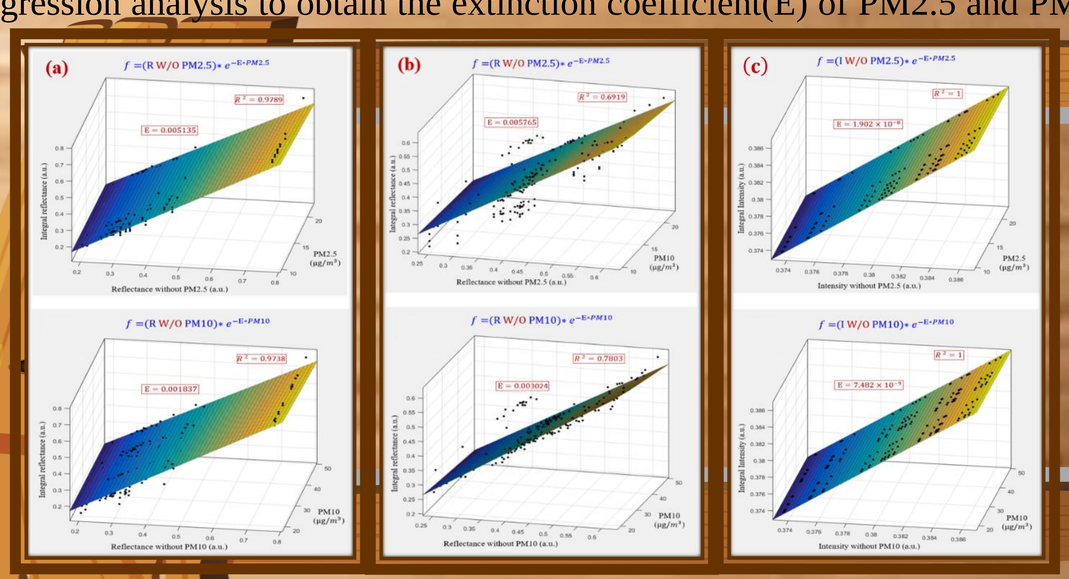


Fig.5 Band spectral data and aerosol regression analysis results (a) Visible light band (b) near-infrared band (c) far-infrared band.

Then, the PM2.5 and PM10 concentrations will be calculated by Equation 3-1 and Equation 3-2 in Fig.6 .

$$f = (\text{R W/O PM2.5}) * e^{-E*PM2.5} \quad (3\text{-}1)$$

$$f = (\text{R W/O PM10}) * e^{-E*PM10} \quad (3\text{-}2)$$

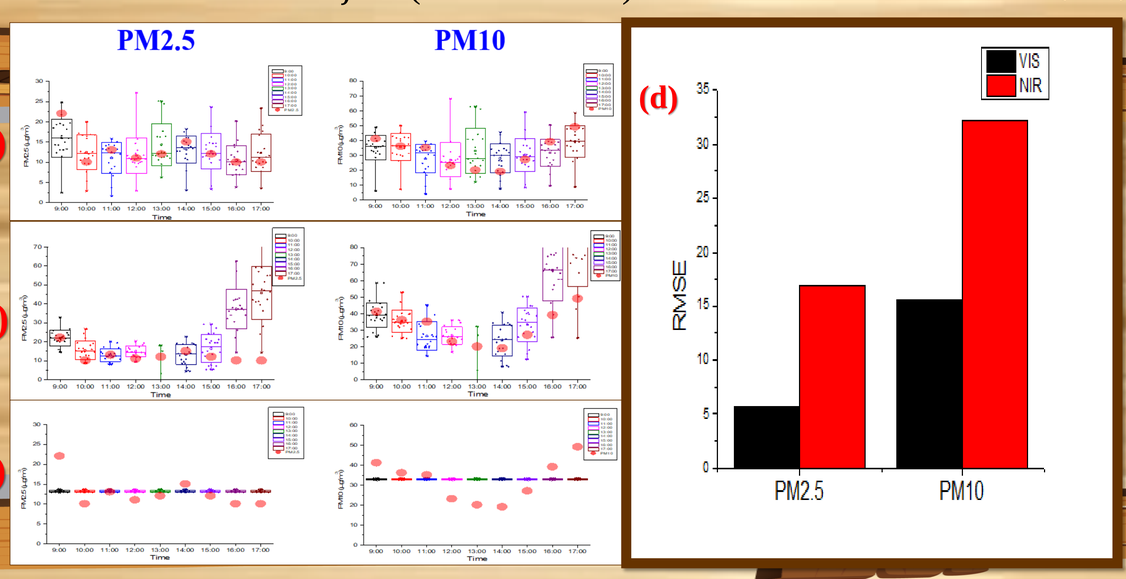


Fig.6 (a–c) Measurement station data and aerosol concentration by (a) Visible light band ,(b) near-infrared band ,(c) far-infrared band estimation distribution results.(d) Visible light and near infrared estimation.

## Conclusions

The results of this study show that PM 2.5 and PM 10 in air pollution can be analyzed in the visible and near-infrared bands, and in the visible light band, the accuracy of PM 2.5 and PM 10 is higher , and in the far - infrared The band portion is hardly affected by it. In the regression analysis of spectral data and particulate matter , the visible light band has a very high correlation coefficient, and when estimating the aerosol concentration , there are also accurate results.The analysis method allows the mobile phone camera to analyze the PM 2.5 and PM 10 at the time by shooting images to increase the convenience and immediacy of the detection.