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Paper Authors

KISHORE KUMAR MATURI, THIRUPATHI REGULA, EDARA SREENIVASA REDDY

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A STUDY ON FINDING HUMIDITY AND MOISTURE CONTENT IN COTTON FIBRE USING DIGITAL IMAGE PROCESSING ADVANCES

KISHORE KUMAR MATURI[1*], THIRUPATHI REGULA[2], EDARA SREENIVASA REDDY[3***]**

[1, 2] IT Department, Higher College of Technology, Muscat, Sultanate of Oman.
[3 Department] of CSE, Acharya Nagarjuna University, Guntur, India
[*] kkmaturi@yahoo.com , ** regulathirupathi@gmail.com , *** esreddy_67@yahoo.com .

Abstract: Moisture is a critical characteristic within the trade of cotton, its impact on bale weight however it effects on fibre quality, price and processing. Number of strategies are used to degree moisture in seed cotton, lint and fuzzy seed, each has its various benefits. Former's might also don't have the equipment to check the moisture content which ends up in degrading the fine of cotton. This evaluation is focused to find the technical matters and comparisons concerned in in moisture using by image processing methods. Finding moisture in easiest manner that's useful to the formers to take precautions from harvesting to garage of cotton. There are many kinds of devices and strategies to be had within the marketplace to discover the moisture. Maximum of them is high-priced, having greater technical operations and used inside the ginning degree not at harvesting and storage level. This study focused on image-based techniques like microwave imaging and infrared thermal imaging techniques. Examine and Comparisons will make the first-rate approach, find the similarly requirements and cons and pros of the methods.

1. Introduction

Once harvested, seed cotton needs to be removed from the harvester and saved before its miles brought to the ginning manufacturing facility. Seed cotton is eliminated from the harvester and placed in bales, fantastically compact gadgets of seed cotton. The satisfactory of cotton based totally on many parameters like the time (Humidity variation in environment) of harvesting, way of amassing cotton, the vicinity of harvesting. These parameters result in the cotton have infected with impurities. Whilst the attributes of cotton purchased from farmers was of vital significance to fabric producers, these attributes had been largely unknown on the time of the transaction. The future transactions for exporting or processing is purely depending on the fibre quality. The quality of fibre depends on the moisture and impurities of cotton fibre. Furthermore, the cotton fibre is hygroscopic material. It has the possibility of gain or loss the moisture depends on the temperature. So, the management of preserving moisture level is important until the further process. Generally, the loss of weight or gain of weight is affected by the moisture level in cotton fibre. The best management of moisture level gives the best price for the formers and as well as merchandizers. The moisture level in cotton is range between 5% Moisture Content to 10% Moisture Content. An American Society for Testing and Materials (ASTM standard) suggested the best quality cotton humidity range between the temperature of 21±1°C and 65±2°C % relative humidity when testing cotton fibre.

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2. Literature Review

There many styles of approaches and strategies involved inside the locating of moisture in cotton. Some of them which deals closer to digital imaging techniques given below. A) Microwave imaging technique B) Thermal imaging technique.

In this paper we are discussing finding moisture content using digital image processing primarily based techniques. Before discussing the strategies, it is great to know that what is light and what is electromagnetic spectrum.

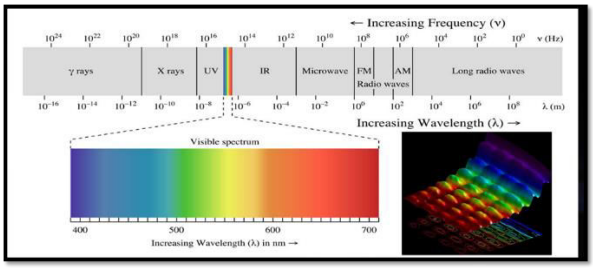

Fig. 1. *Electromagnetic spectrum*

What happens when an object is impacted by an electromagnetic wave? If the material is transparent to the frequency, the wave can be transmitted to a large degree. If the fabric is opaque to the frequency, the wave can be fully thought through. Through the material, the wave can also be absorbed, suggesting that there is some interaction between the wave and the fabric along with the molecules heat agitation, Partial transmission, reflection, and absorption can be achieved. These characteristics are usually associated with visible light, but they apply to all electromagnetic waves.

Table 1 Wavelength and Characteristics of Bands

Band Name	Wavelength(μm)	**Characteristics and Uses**
Visible blue	0.45 – 0.52	Maximum Water Penetration
Visible green	0.52 – 0.60	Good for measuring plants vigour
Visible red	0.63 – 0.69	Vegetation discrimination
Near infrared	0.76 – 0.90	**Biomass and Shoreline mapping**
Middle infrared	1.55 – 1.75	**Moisture content of soil and vegetation**

There are numerous imaging techniques based on the idea of frequency and wavelength.

- Gamma – Ray Imaging
- X – Ray Imaging
- Ultra-violet Band Imaging
- Visible Band Imaging
- Infrared Band Imaging
- Radio Wave Imaging

2.1 Why Infrared Band considered as important

Maximum of the imaging bands not completely relevant for our requirement. The current researches is using broadly the microwave band, infrared band, visible band. some researches is used the microwave imaging however it isn't always effective the substances like cotton, coconut fibre, flowers and so on... The microwave imaging device need transmitters and receiver antennas which may be very felicitation, hard to function, and might have greater weight. The microwave and infrared regions of the electromagnetic spectrum overlapped.Infrared radiation is typically produced via thermal movement and the vibration and rotation of atoms and molecules. Electronic transitions in atoms and molecules can also produce infrared radiation.Infrared radiation extends from the nominal red edge of the visible spectrum at 700 nanometres (nm) to 1 millimetre (mm).

3. What's Infrared Thermal Imaging?

Infrared thermal imaging is a new technique to observe the light or temperature which is reflected

by objects. The visible light is observed by normal human eye. The infrared regions of light should not able to observe by human eye. The need of capturing these invisible rays is necessary for many applications. By using thermal cameras, it is able to acquire the thermal images. These cameras change the temperature variations by human observable snap shots or videos. The infrared region in the electromagnetic spectrum occupies range from 0.7µm to 12.5µm of wavelength. The available region of wavelength divided in to three bands. a. Near IR. b. Mid IR, and c. Thermal IR. The thermal Infrared Region is used within the thermal Imaging. The infrared imaging system operates in the band 10.0 to 13.4 µm

3.1 Infrared Imaging Types

Most of SLR digital cameras having the feature night vision. For the purpose of night vision those use the sensors like CCD and CMOS. These sensors sensitive for near infrared region. Which covers the non-thermal part of electromagnetic spectrum. Many types of infrared filters available to stop unwanted light range in the daytime. Consequently, a neighbouring supply of IR illumination throughout the night or during the daytime functions as the primary source of IR radiation which is then considered in different ranges by means of the object being photographed producing an IR photograph. Infrared Filters are used in many ways to block the visible light in order to get different effects.

3.2 Thermal Imaging

The object having above absolute zero temperature emits the IR radiation. Thermal imaging is a technique which capture the thermal variation above absolute zero temperature. It focuses the Thermal imaging part of spectrum apart from the IR band nearby. This magnificence of IR imaging works along the following steps:

1. A distinctive lens is employed to focus on the light IR emanating from the objects within the scene. A phased array of IR detectors scans the sunshine to make an in-depth temperature sample referred to as thermogram.

2. This thermogram is transformed into digital image and converted into viewable format. This digital information display devices or storage area.

3. Now the image format is ready to analyse the moisture.

4. Methods and Techniques used to find Humidity and Moisture in cotton fibre

Summary of Methods for finding Moisture Content in Cotton.

Table 2 Summary of Methods for finding Moisture Content in Cotton

Purpose	Method/ Technique	Disadvantage
Seed Cotton Measurement	Microwave imaging technique.	Need more equipment and poor detection of moisture content.
Examination of cotton fibre using Thermal Imaging	Focal Plane Array Detector and a Single Reflectance Accessory. Advanced fibre information system (AFIS)(Cotton Structure & Quality Research Unit, Southern Regional Research Center (SRRC),USA)	Infrared chemical imaging as a tool in the examination of cotton fibre bundles. It focuses on Chemical changes only. And need many samples.

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5. Thermal Imaging effect on cotton bundles

In the infrared frequencies the water molecules vibrate and rotate states only. No electronic transition occurs. Special thermal imaging cameras sense the radiation transforms to photographic snapshots. The following images shows the moisture effects on cotton fibre bundles in terms of thermal radiation.

Sample Thermal Images of Cotton Bundles:

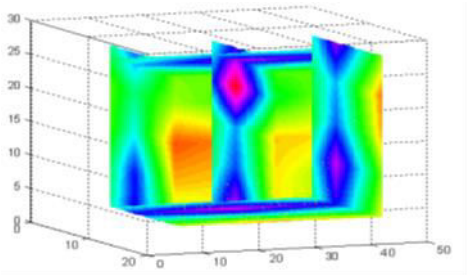

Fig. 2. *Sample Microwave thermal imaging of Cotton Bales*

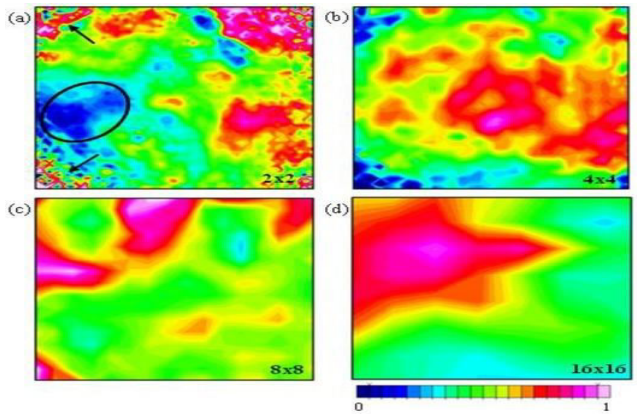

Fig. 3. *Sample Microwave thermal imaging of Cotton Bales*

Description: High variability of commercially produced bale, exhibiting variations in moisture from below 7% (yellow brown) to well in excess of 12-13% (blue-pink).

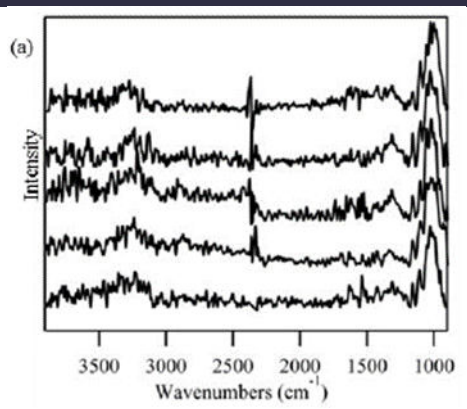

Fig. 4. *Fourier transform infrared spectroscopy (FTIR) spectra of a cotton fibre bundle.*

6. Conclusion and Future Prospects

Most of the strategies targeted on the usage of microwaves techniques. Which need heavy equipment and not economic also. My goal is to locate moisture in cotton fibre using Infrared Imaging via using superior evaluation strategies in digital image processing. The method is used to analysis the moisture quantity in cotton fibre in the normal storage area or at any harvesting point.

I am going to use the thermal imaging sensor for the acquisition of digital thermal image. It is economically equivalent to mobile phone cost which can attach to the mobile phone also.

The obtained image is going to be examine inside the series of steps like sampling, quantization, segmentation. and so forth. Different strategies to discover the moisture content in the end it gives the measurement of Humidity in the cotton fibre.

Infrared imaging technology can be used to image bale and then perform calculation to derive an estimate of the variability of the hidden interior Humidity and Moisture, there by altering personnel to damaging levels of unseen moisture before fibre degradation occurs.

And it is more prevalent for detection of finding other impurities which is contaminated with the cotton. Comparatively other methods the infrared imaging technology is simple to use and

can measure the accurate moisture level and other impurities in cotton.

The number of studies applying IR and Thermal imaging to cotton fibre has been limited. It needs to build the applications like to measure the humidity and moisture levels accurately in terms of number values using thermal spectra.

My study sought to establish a new working method that produced Thermal spectra of cotton bundles with reduced spectral noise or artifacts. Finding the moisture regions, analyze and quantify the common moisture content material inside the fibre bundle.

7. Acknowledgments

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