

MOISTURE CONTENT DETECTION OF RICE GRAIN BASED ON OVEN DRYING TECHNIQUE USING A CIRCULAR MICROSTRIP PATCH SENSOR

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Abstract. The circular microstrip patch sensor based on oven drying technique for detecting the moisture content of rice grain. The circular microstrip patch sensor is designed at 6GHz with the good return loss -28dB and gain 3.41dB as well as low insertion loss. The sensor is designed with using FR4 (lossy) substrate with $\epsilon_r = 4.3$ permittivity and $h = 1.6$ mm thickness. The outer and inner radius of circular patch sensor is 14.5mm and 13.5mm respectively. A 50 ohm SMA female connector will be used as the feeding port of the microstrip on the fabrication and measuring time and measured the moisture sensor by using the vector network analyzer.

Key-words: circular microstrip patch sensor, rice grain, moisture content, oven drying technique.

1. INTRODUCTION

The superiority of rice grain brings on a high demand in the India as well as especially in Asia [1-4]. The price of rice is getting costly and due to the moisture of rice percentage is going down so it is very important to protect the rice. The circular microstrip patch sensor is detected the moisture content of rice at 6 GHz. The Various techniques have been designed for detecting the moisture content of rice [5-7]. An annular photoelectric sensor was also used to determine moisture content of rice grain by applying the Lambert's law. Recently, microstrip antennas have been widely used in many applications such as communications, medical and agriculture [8-12]. The objective is to establish the relationship between reflection coefficient of the sensor and moisture content in rice grain [13-15]. The circular microstrip patch sensor as shown in figure 1.

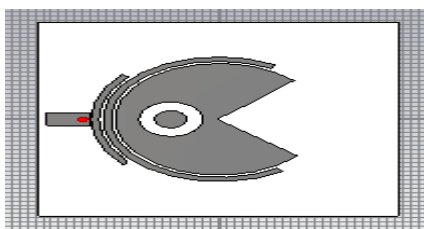


Fig. 1: The design of circular microstrip patch sensor

2. MATERIAL AND METHOD

a. Microstrip Patch Sensor

The proposed patch antenna sensor is designed using CST Microwave studio. The resonant frequency is at 6GHz. The sensor is designed with using FR4 (lossy) substrate with $\epsilon_r = 4.3$ permittivity and $h = 1.6$ mm thickness. The outer and inner radius of circular patch sensor is 14.5mm and 13.5mm, respectively as shown in figure 2. A 50 ohm SMA female connector will be used as the feeding port of the microstrip on the fabrication and measuring time.

b. Sample Preparation

The samples is prepared by using the standard an oven drying method for the rice grain samples [16-20], but normally can be find out the moisture content 30%-40% approximately on wet basis. But actual find the moisture content can be determined by using standard an oven drying method, which is helpful to determined the moisture content easily and less time consume [21-25].

Moisture content (%) = $\frac{\text{mass of water}}{\text{dry mass of sample}} * 100\%$

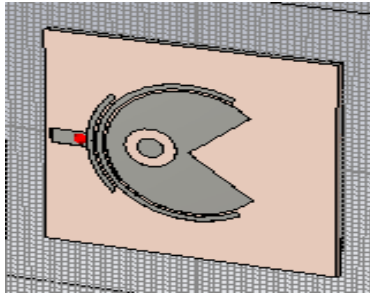


Fig. 2: Circular microstrip patch sensor

c. Reflection measurement

The moisture content of rice grain detect by the vector network analyzer (VNA). It is used to measure the reflection coefficient of the sensor with and without the samples in operating frequency range 6GHz with return loss -28dB as shown in figure 3.

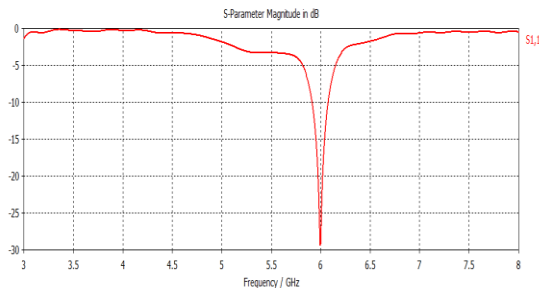


Fig. 3: Return loss of Circular microstrip patch sensor

The magnitude and phase is also discussed which is important parameter of microstrip patch sensor for detecting the moisture content of rice grain as shown in figure 4-5.

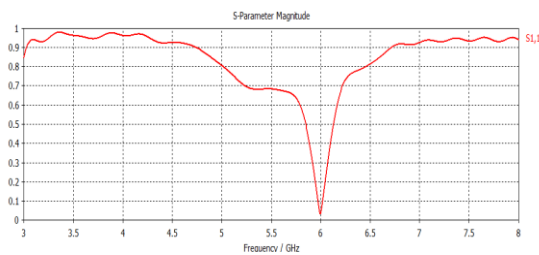


Fig. 4: Magnitude of Circular microstrip patch sensor

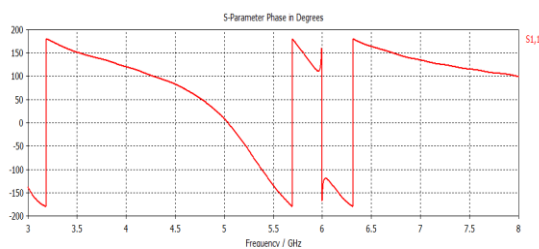


Fig. 5: Phase of Circular microstrip patch sensor

The gain of the circular microstrip patch sensor as shown in figure 6.

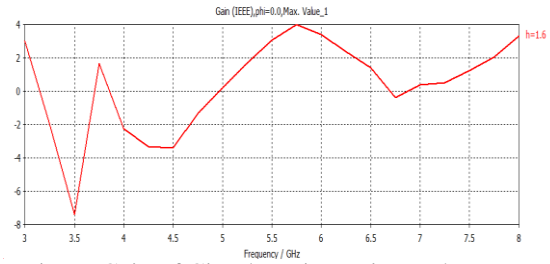


Fig. 6: Gain of Circular microstrip patch sensor

3. RESULTS AND DISCUSSION

The circular microstrip patch sensor is designed at 6GHz with the good return loss and gain is -28dB and 3.41dB by using the CST microwave studio and the standard oven drying technique.

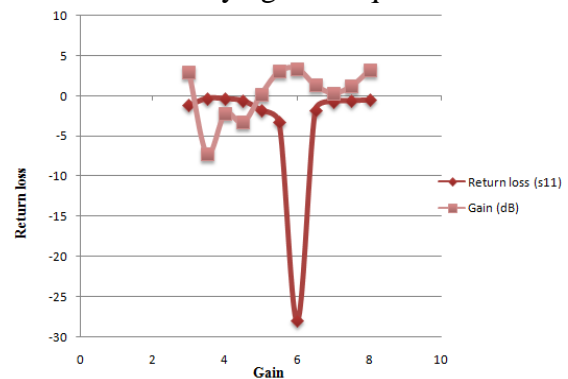


Fig. 7: Comparison of Return loss and Gain

4. CONCLUSION

The rice grain is very important for human being and this is very important how to protect the rice from the moisture content. The design of circular microstrip patch sensor is analyzed which will be become a very helpful for human being for detecting the moisture content. It is operated by 6GHz with the return loss -28dB and gain 3.41dB.

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