Department of Electrical, Electronic and Computer Engineering

Department of Electrical, Electronic and Computer Engineering	**Key words**	Control, measurement, optical fiber sensing

Doctor of Engineering/Professor

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Education

Fukui University of Technology Graduate School of Engineering, Electrical Engineering Master's Program
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Professional Background

Lecturer, Associate Professor, Fukui University of Technology

Consultations, Lectures, and Collaborative Research Themes

Distribution measurement using the optical fiber sensing

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Main research themes and their characteristics

「Application of the fiber optical sensing technology to agricultural field」

"The smart agriculture" is required as a new form of agriculture. In this agricultural method, distribution measurement data of agricultural farmland/crop is acquired, and various agricultural equipment is automatically controlled based on the data. As a result, it is possible to reduce labor and improve the yield and quality of agricultural products. However, current methods of measuring data in agriculture measure only a few points on a large farmland. "The smart agriculture" cannot be realized with this measurement method, and farmers are supplementing the lack of data with experience and intuition. The development of distribution measurement technology to solve this problem is an issue.

In this research, we are considering applying the optical fiber sensing technology to agriculture field. The most important characteristic of the optical fiber is that it can distribution measurement. The measurement principle is as follows. When laser light is incident on the optical fiber, part of the light (the backscattered light) returns. The backscattered light reacts to changes in

"temperature" and "strain". Therefore, the optical fiber can be used as temperature and strain sensor by analyzing the backscattered light. Another feature of the fiber optical sensor is that it has a diameter of 0.25 mm and does not interfere with farm work even with a protective layer. And, the measurement interval of the optical fiber sensor is 2 cm, and no power supply is required except for measuring equipment. These characteristics are suitable for measurement in the agricultural field. On the other hand, there are various problems. The biggest problem is that the types of data that can be measured by ordinary optical fiber sensors are only "temperature" and "strain". Research is developing fiber optic configurations to measure agricultural parameters "Humidity", "Nutrient", "Water content in soil", etc. Currently, we are developing a configuration for "humidity" measurement, and are verifying whether humidity measurement can be realized by coating an optical fiber with a water-absorbing material (Fig. 1). This utilizes the relationship between the amount of change in humidity and the strain generated by the water absorbing material. As shown in Fig.2 and 3, the coating optical fiber causes a frequency shift amount due to a change in humidity. It was also found that the amount of frequency shift differs depending on the material to be coated. In the future, we will build an algorithm for real-time measurement of humidity with this coating optical fiber. In addition, we would like to develop the multi-parameter measurement optical fiber such as " temperature" "humidity" "nutrition" and "water in soil".
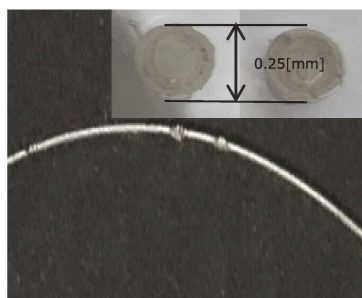

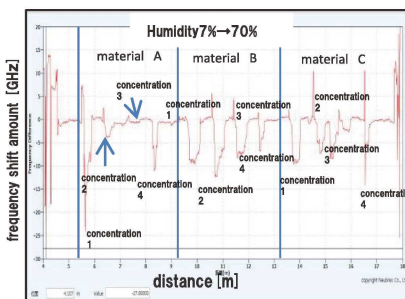Fig.1 The Optical fiber sensor coated with water absorbing material

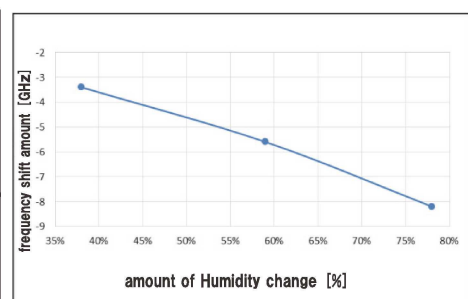Fig.2 Humidity response measurement results with water-absorbent material coating

Fig.3 Relationship between the amount of change in humidity and the amount of frequency shift caused by coating water-absorbent materials

Major academic publications

Masanori Nakamichi, Shunshoku Kanae,
"Estimation of the Pulmonary Elastance Using a Recursive Parameter Estimation Method and Setting of the Ventilation Condition Using Fuzzy Logic",
Transaction of the Institute of Systems, Control and Information Engineers, 27-12, pp.469-475, (2014)