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Big Data Analysis on Oyster Growth and FLUPSY Environment

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개체굴 성장 데이터와 양식 FLUPSY 환경 데이터의 빅 데이터 분석

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ABSTRACT

In the era of the fourth industrial revolution, the application of big data analysis technology is crucial in various industries. In this regard, considerable research is necessary to improve aquafarming productivity, particularly in fish culture, which is one of the primary industries in the world. In this study, a sample experiment using a flop was conducted to improve oyster productivity in fish farms, and a flush was installed in an environment similar to aquaculture farms. Thereafter, the temperature data of the water environment where the formation of burrows considerably improved were collected; the growth rate of burrow seeds was also measured. The gathered experimental data were examined by time series data analysis. Finally, a system that visualizes the analysis results based on big data is proposed. In accord with the results of this study, it is expected that more advanced research on the productivity improvement of oyster aquafarming will be performed.

Keywords : Oyster Aqua-farming(굴양식업), Big Data(빅데이터), Visualization Data(데이터 시각화)

1. Introduction

Local oyster farming, which is regarded as a high value-added product in the aquaculture industry, is an important business for entering the overseas market. The research that accumulates and analyzes the growth data of individual oysters by integrating IoT, Cloud, and Big Data technologies into the farming of oysters is expected to be a great foundation for the development of the smart aquaculture industry.

In this experiment, for the experiment of individual oyster growth, we installed flupsy on the coast of aquaculture, measured environmental data, and measured and visualized and analyzed the data of individual oysters growing in the flupsy environment.

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2. Methodology

2.1 FLUPSY(FLoating UPwelling System)

FLUPSY is a floating ascendant structure and is a hardware structure used in oyster farming. According to the presentation of the Korean Fisheries Science Society conference, it is known that it has a very positive effect on the stability of DO (Dissolve Oxygen) values for the growth of a population of oysters and the round shape formation of a commercial oyster [1]. In this study, FLUPSY used in the aquaculture industry was constructed to construct an experimental environment. Based on the stability of the DO value provided by FLUPSY, an experiment was prepared to analyze the water temperature and the growth rate of the seed population.

2.2 DOE(Desing of Experiments)

As an application field of statistics that is used for the purpose of designing an efficient experimental method and analyzing the results, we plan an experimental method that collects information from existing variables. To solve the problem to be solved, it is planned to design a statistical analysis method for data for designing, analyzing, designing an experimental process, and collecting data. Traditional DOE introduces the principles of randomization, blocking, and replication, and experiment planning using these principles has been generally used.

Since then, through various studies, Split-Plot, Definitive Screening Designs (DSD), Response Surface Methodology (RSM), and Custom Design have been proposed[2]. Figure 1 below shows the factor model for traditional DOE.

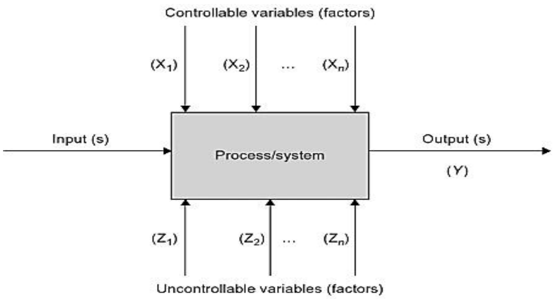

Fig. 1 General factors model of a process

2.3 Big Data & Small Data Analytics

Small data analysis does not refer to data analysis before the Big Data era, but we intend to use the usefulness of Small Data analysis that can be overlooked due to changes to the Big Data era. Although Small Data has fewer variables to consider and less data processing time, it focuses on understanding the characteristics of the data, the relationship between variables, and the nature of the problem than the algorithm. The algorithm used to analyze small data is different from the algorithm used to analyze big data. However, there is no doubt that Small Data will grow into Big Data through the usefulness of answering targeted queries and the development of a new Data infrastructure.

The advantage of applying Small Data Analytics to create a larger data set with data gathering, pooling, extension, and link, and accessing it with an open data analysis method for sharing and reuse is to prepare for the case of expanding to a larger data infrastructure[4].

Based on basic Data Analytics, the process of Small Data Analytics can be described as follows. It is represented by the definition of the problem, data acquisition, data organization, data normalization, data transformation, exploration through statistics, and visualization of it.

2.4 Data Visualization

This refers to the process of visually expressing and delivering data analysis results for easy understanding. The purpose of data visualization is to convey information clearly and effectively through various means of expression. The step classification of the data visualization procedure is as follows.

The information organization step is a step of assigning order by classifying, arranging, and organizing data that is involved in the perception of user information or existing in a chaotic state, and the information visualization step is for the case of participating in the user's perception of information and for efficient information delivery It is the step of applying the method of presenting the optimal stimulus to the sensory organs of visual, auditory, tactile, taste, and olfactory, and the interactive step is designed to design the user experience in terms of interaction between information and the user, as well as the cognitive factors of the information. It is a stage that utilizes perceptual factors together and closely interlocks with the information visualization stage, while simultaneously considering the characteristics of the input technology[8]. Areas that utilize this data visualization include information visualization, which summarizes large-scale data, and scientific data visualization, which enables easy exploration of complex data such as experiment results and simulation data[9].

3. Results and Discussion

3.1 Experiment setup and conditions

Among the environmental data of FLUPSY, the water temperature, which is the most important environmental factor for the growth of individual oysters, is measured, and based on this, the weight and size change values of individual oysters by FLUPSY are measured.

An individual environment FLUPSY was installed to classify individual object sizes and densities for each FLUPSY, and three FLUPSYs under the same conditions were installed to create an experimental environment. In this experiment, based on the DOE (Design of Experiments), the size and density of the dens for FLUPSY were set as control factors, and three FLUPSYs with the same conditions were placed.

Table 1 Design control factor for oyster FLUPSY

Size(㎝)	Density(Number of objects)	Etc.
Large: over 4㎝	Low: 400 piece	3 EA
	Middle: 600 piece	3 EA
	High: 800 piece	3 EA
Small: inner 2㎝	Low: 1000 piece	3 EA
	Middle:1500 piece	3 EA
	High: 2000 piece	3 EA

Then, the change in weight and size according to the time for each FLUPSY was measured. Table 1 shows the control factors set in this experiment.

The measurement process of the experiment to measure the water temperature, which is the size, weight, and environmental data of each installed FLUPSY is as follows.

① Measurement time recording
② Temperature measurement for each FLUPSY (fixed measurement position)
③ Weighing record after 30 minutes of water draining to measure the individual oyster weight of each FLUPSY
④ Select 100 objects for each FLUPSY
⑤ Individual oyster size measurement record with 10 sets
⑥ Calculate and record the average and standard deviation of the measured size data

Figure 3 shows the overall process of the experiment.

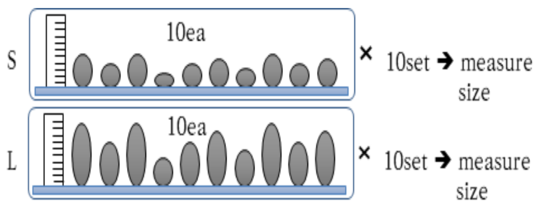

Fig. 2 Measure size of oyster

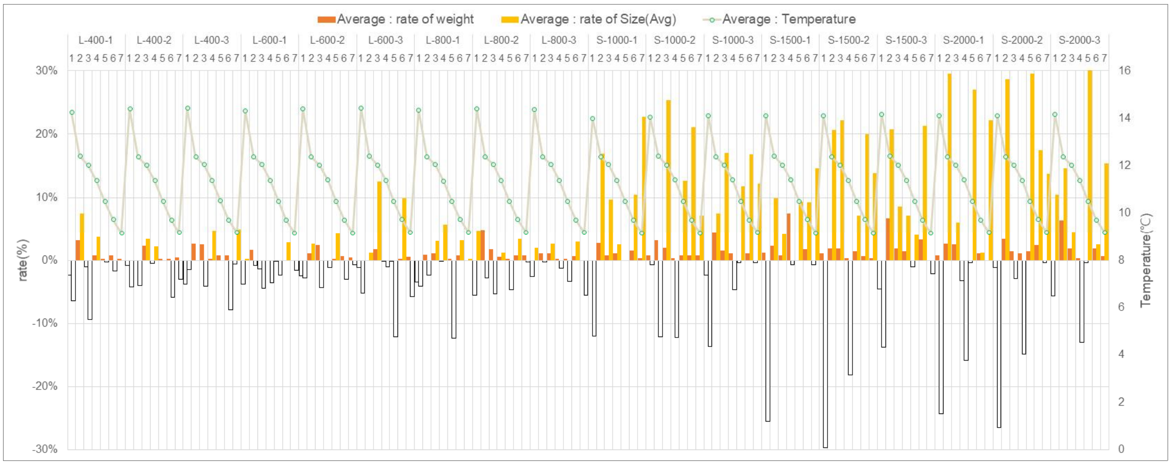

Fig. 4 Oyster growth rate data by vertical bar graph and FLUPSY water temperature by line graph

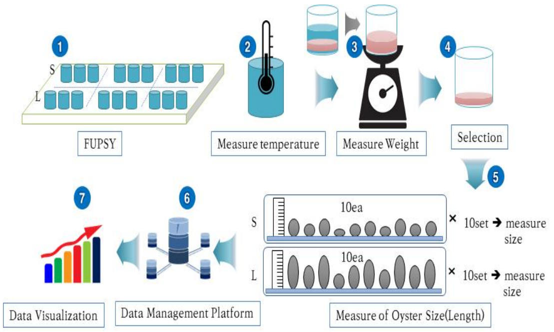

Fig. 3 Process of Experiment

In order to measure the growth data of the individual oysters, after the initial set up, the weight and the size were measured seven times at a weekly interval based on the size and density, which are the control factors of the individual oyster FLUPSY. The growth rate of the individual oyster is composed of a recursive algorithm that displays the difference and the difference of the measured round based on the measured value before the measured round, and the measured round continues to the previous round of the next measured round. The recursive algorithm is a structure that calls itself from a function structure and is a traditional method in the field of computer science. Time series data analytics can be applied to the population growth rate using the recursive algorithm. Time series data is a data analytics that uses time as an independent variable as a set of values sequentially observed at time intervals, and applied to growth rate data analysis.

3.2 Visualize Oyster Growth Data

A vertical bar graph was used to display two ratio data in the form of visualization to analyze the growth rate of the population in the FLUPSY environment. The two ratio data are shown as a comparison graph for each measurement round (time series) by FLUPSY. In calculating the growth rate, the difference between the weight of the previous measurement and the size of the individual was calculated based on the weight of the previous measurement and the size of the individual, and this was expressed as a ratio based on the previous measurement. FLUPSY was set as the first criterion and the measurement round was set as the lower criterion. When the water temperature value for each measurement is displayed on the basis of FLUPSY, the temperature is shown as a downward line in a periodic manner. The weight and size increase/decrease ratio of individual oysters was displayed by measurement rounds (time series) by FLUPSY, and FLUPSY water temperature data by measurement rounds (time series) was displayed in conjunction. Figure 4 is a basic graph that visualizes this data distribution. In this Data Visualization, it is important to display the growth rate of individuals according to the density control factor for each FLUPSY controlled by the number of individuals, and reflecting this, it is represented as a dual-axis mixed graph that mixes vertical bars and lines.

3.3 Discussion

The purpose of this experiment was to construct a system for analyzing growth rates based on population growth data and environmental data. From the viewpoint of aquaculture industry, there is a limitation that the growth rate is not remarkably displayed in time. While installing FLUPSY at the site of the aquaculture industry, creating an experimental environment for analysis, FLUPSY is fabricated in a double structure, and the interior is designed with a net so that the water can be submerged in order to measure the weight. Became. However, since there is an empirical limit to completely remove and measure the moisture in the curvature of the individual oyster, the process of standardizing the water drainage work time was applied to each FLUPSY. Given the empirical limitations of these experiments, it was concluded that a number of complementary studies are needed to show the correlation of measured data.

In terms of Data Visualization, the growth rate and water temperature of individual oysters were displayed so that they can be grasped based on FLUPSY, and this was expressed by comparing the increase and decrease of growth rate according to the reference size and density of the population. By visualizing the data in the Small Data dimension that can be extended to Big Data, it is possible to determine a control factor that is more prominent in the growth rate of the individual oyster against the density controlled by the reference size and population.

4. Conclusion

In terms of the basic research of Big Data for the design of a smart aquaculture system, there are limitations in the measurement data of the experiment, and we intend to apply the steps of this data analytics. In this experiment data, there are some parts where the control factor is not sufficiently controlled and the reliability of the measurement data is not secured. However, based on the scalability to Big Data, Small Data analytics was attempted, and it can be said that it was the basis for preparing more detailed experimental measurements in the analysis phase.

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