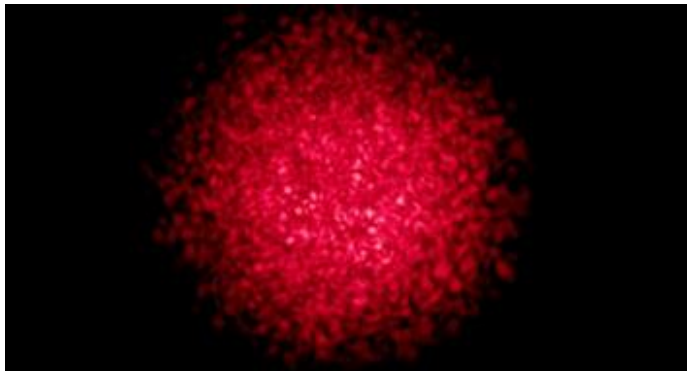


NO. 1

Year 2023	Summary of Thesis	
Student No.	Last name, First name	
M2220150	Chiba Takato	
<p>(Title) Development of detection scheme for speckle pattern changes in an output light spot from an optical fiber with a PIV method</p>		
<p>Typical uses of optical fiber include transmission medium for information and communication and fiber optic sensor. Speckle pattern as shown in Figure1 are typically observed within an output light spot from a graded index multimode fiber(GI-MMF). In this research, speckle pattern changes caused by application of external disturbances, especially the phenomenon in which speckle patterns appear rotating upon twisting motion application onto GI-MMF, is considered for the purpose of possible use as fiber optic sensing scheme. Specifically, the author used an automatic measurement method called a PIV method to analyze the speckle pattern changes. As a result, the following can be clarified.</p>		
		
<p>Figure 1 GI-MMF speckle pattern</p>		
<ul style="list-style-type: none"> By employing an FFT correlation method in the PIV, it became possible to express the speckle pattern rotation phenomenon as a vector quantity in small region called interrogation areas. In addition, by combining it with a software modules that performs circle detection and trigonometric function, it became possible to calculate the amount of speckle pattern rotation up to the number of interrogation areas at most over a given time interval Δt. 		

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NO. 2

- By applying appropriate statistical processing methods on the obtained results, it became possible to express the speckle pattern rotation phenomenon on a two-dimensional graph with time and rotation angle axes, as shown in figure2. In this case effective statistical processing methods include the anomaly score calculation, the sample size observation, and extraction of a typical number using quantiles. In addition, the distribution of results can be estimated by using Kolmogorov-Smirnov test (K-S test).
- After setting appropriate parameters for the PIV, and performing analysis of the speckle pattern rotation using the PIV, the resultant analyzed results can be output while reflecting the actual motions of the disturbance applying mechanism generated in the real world with respect to the direction and the duration of the speckle pattern rotation.
- The obtained results can infer that it will become effective to reduce the size of interrogation area to some extent when analyzing the speckle pattern rotation using the PIV. Specifically, when the author analyzed speckle pattern which was taken with a 1280[pixels]×960[pixels] camera, and using interrogation area in size of which was 16[pixels]×16[pixels], improvement in the temporal resolution in the PIV realized.
- From the results of K-S test, when the speckle pattern rotation is analyzed using the PIV, it become clear that the dataset obtained over a certain Δt was most likely derived from a lognormal distribution. In addition, compared to other trial results, the skewness of the results was found to be possibly changed under certain conditions.

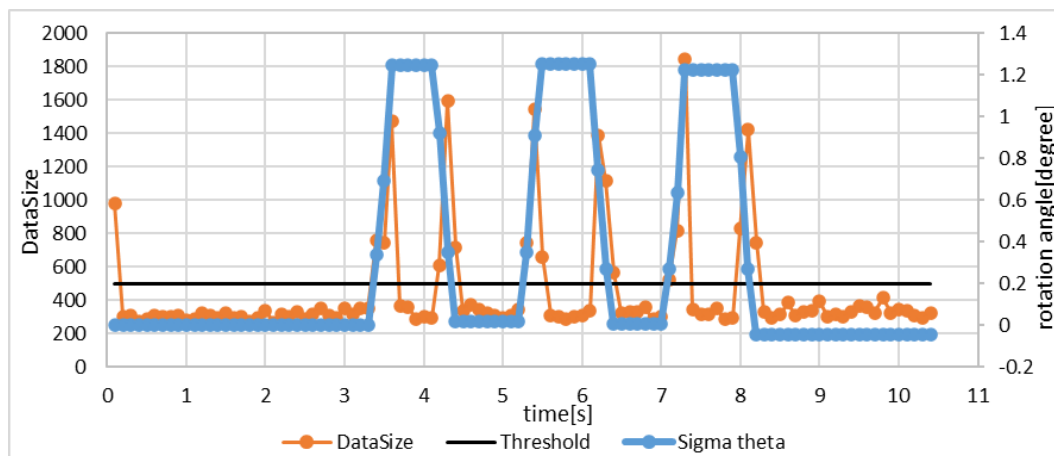


Figure 2 Example of analysis results