Displacement Sensing of an Active String Actuator by an Optical Fiber

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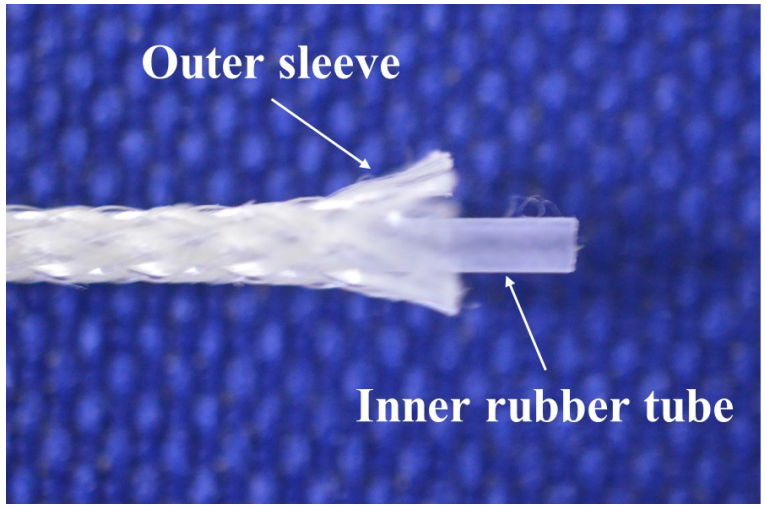
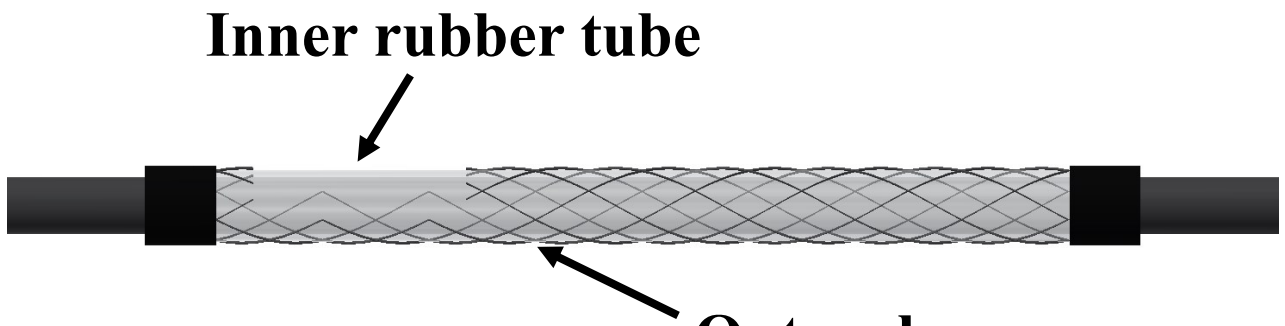
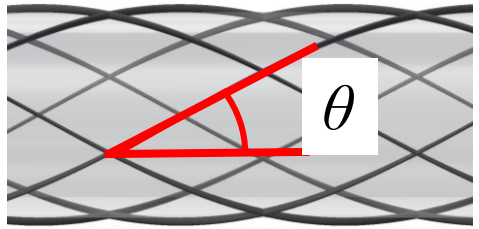
Thin Artificial Muscle

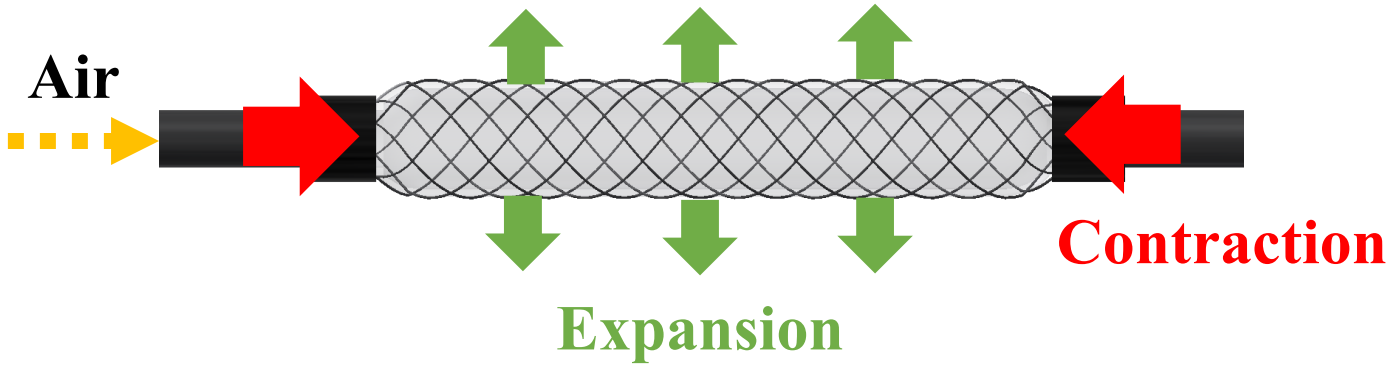
High flexibility and lightweight pneumatic actuator with 1.8 mm in outer diameter

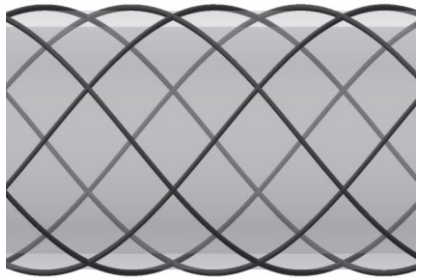




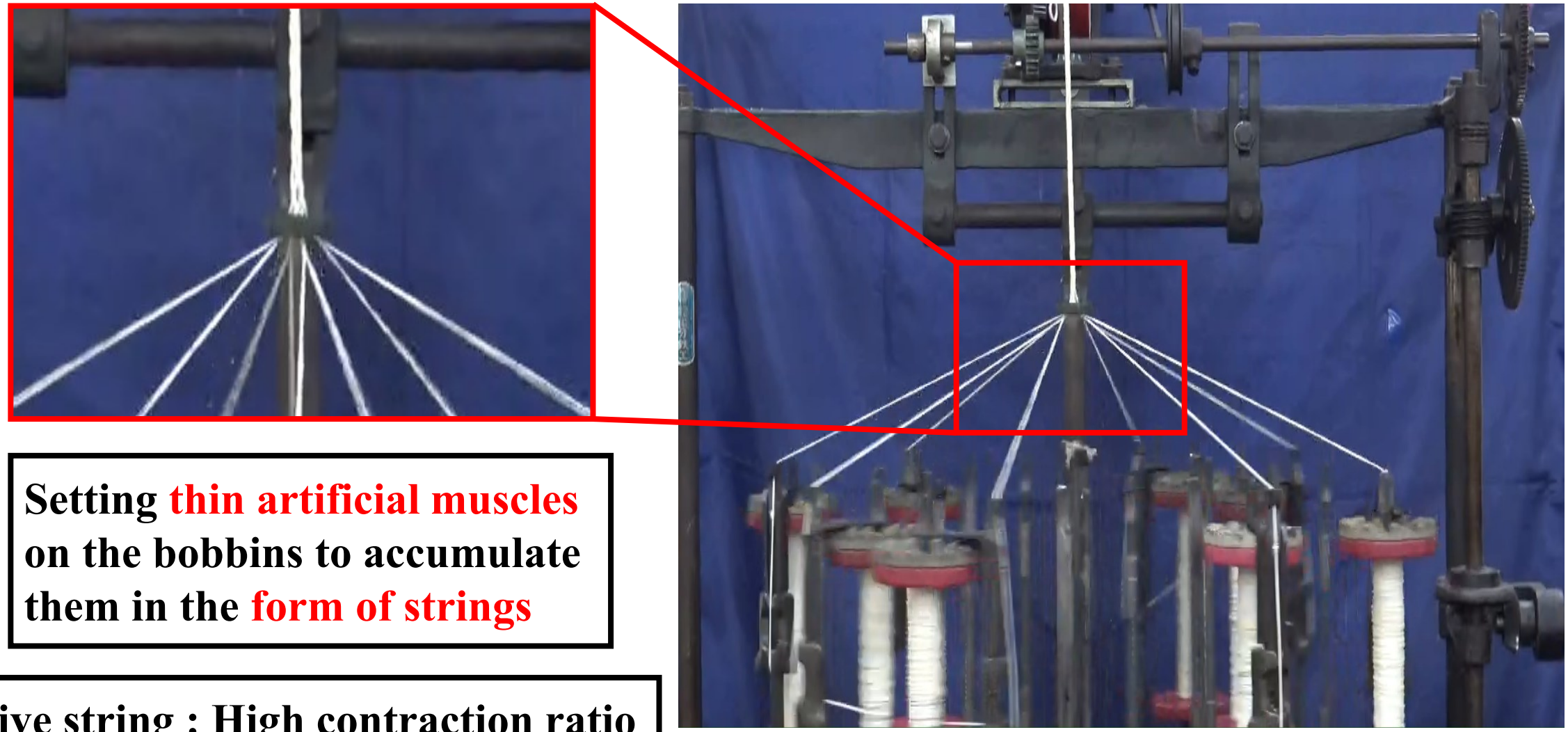


θ: Braiding angle





Production method of an active string

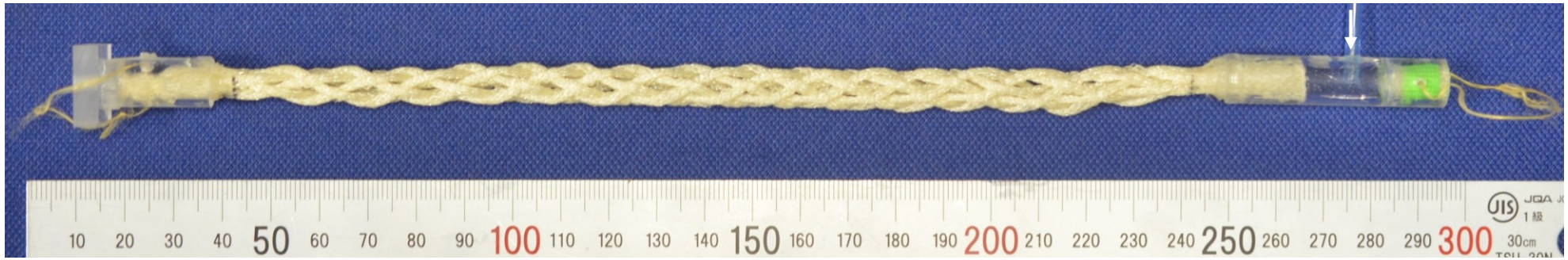


Setting thin artificial muscles on the bobbins to accumulate them in the form of strings

Active string : High contraction ratio
High flexibility [1]

[1] Tian, W.; Wakimoto, S.; Kanda, T.; Yamaguchi, D. Fabrication of "Active String" using Thin Artificial Muscles by String Production Process, Mechanical Engineering Congress (MECJ-21), Online, Japan, 2021.9.5-8; S117-05(in Japanese).

Problem of the active string



Displacement control of the active string is challenging

Linear potentiometer [1]

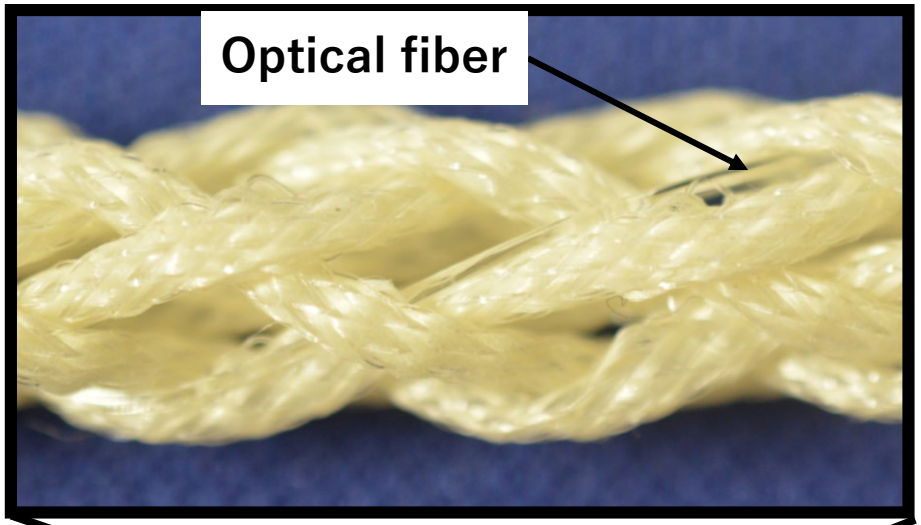
Encoder [2]

Bulky and rigid displacement sensors

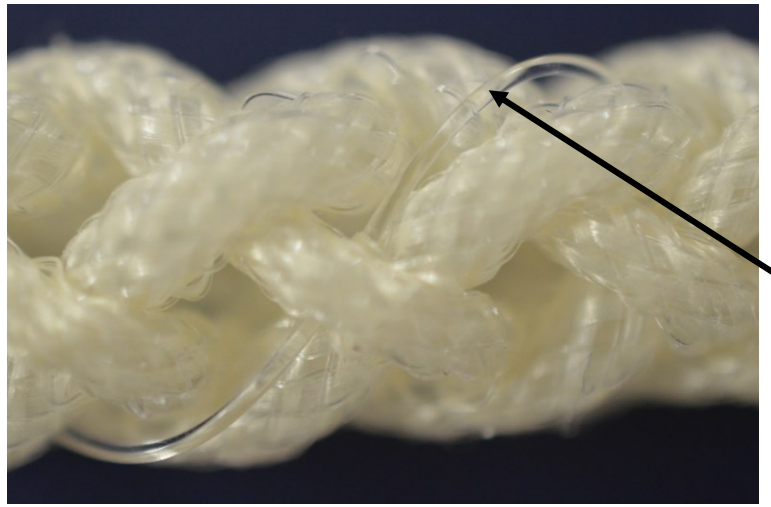
Difficulty of embedding
Interfering the flexible motion

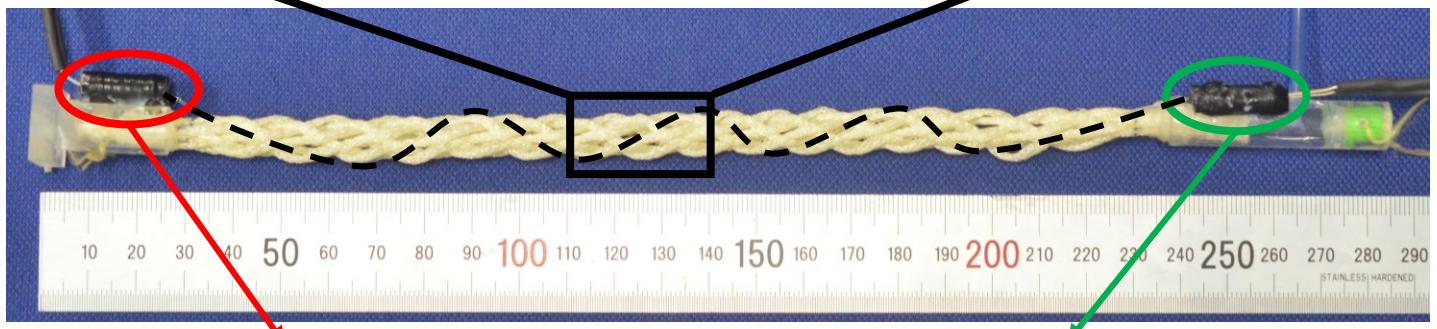
[1] https://www.midori.co.jp/products/lp-fj
[2] https://www.fa.omron.co.jp/products/family/490/

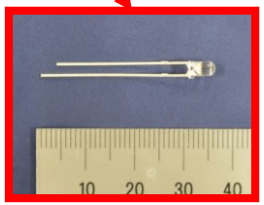
Production method of an active string

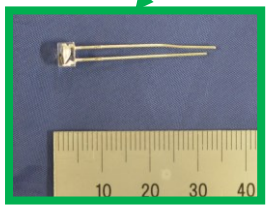


Air









Emitting part：LED

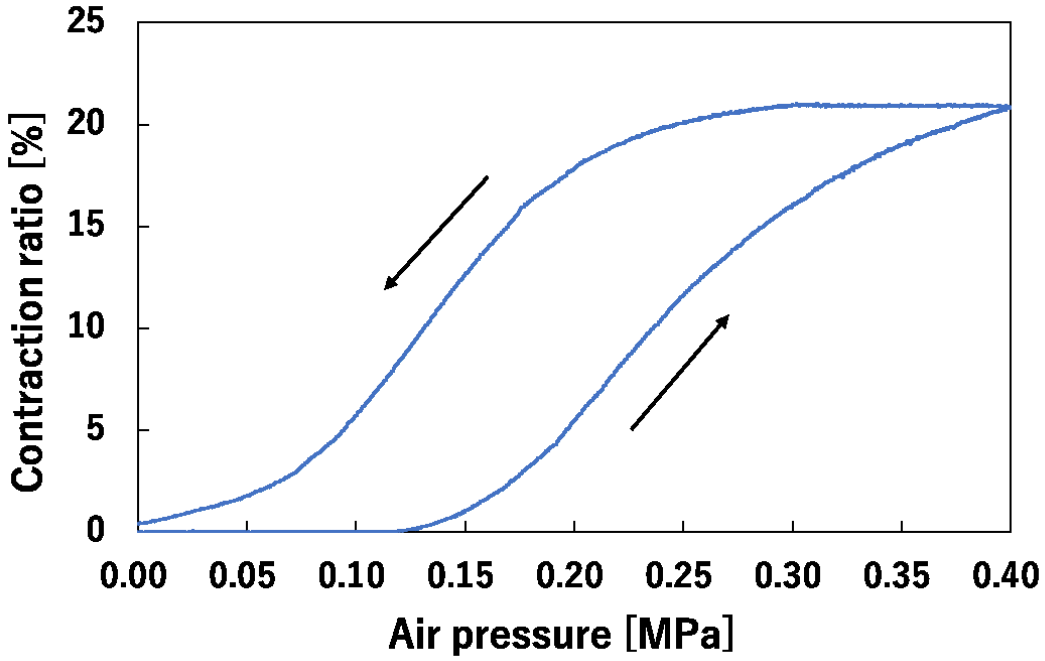
Receiving part：Photo IC Diode

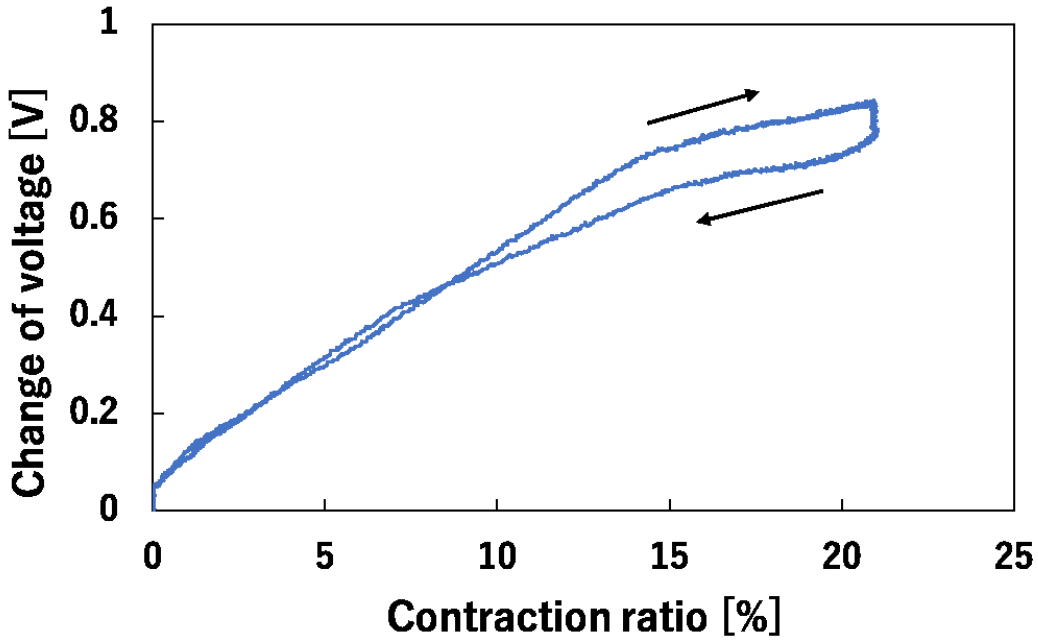
Combination of the optical fiber with the active string (black dashed line)

Contraction of the active string →Decrease of radius of curvature of the optical fiber

Decrease of light propagating in the optical fiber due to bending loss

Results and Discussion





Conclusions

- A flexible optical fiber sensor is combined with the active string to enable sensing of its displacement.
- The experimental results showed that the sensor value of the optical fiber sensor changed with corresponding to the displacement of the active string.

Possibility of displacement estimation of the active string by combining the optical fiber sensor with the active string can be found.