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Space Structure Systems

Education

- Keiaigakuen Senior High School, Chiba, Japan (2013)
- Bachelor of Engineering, Nihon University, Chiba, Japan (2019)
- Master of Engineering, Nihon University, Chiba, Japan - Current

Project Experience

- NEXUS development project (April 2017 ~)
- NEXUS operation (January 18th, 2019 ~)

Master of Research

- Theme

  Deep Learning and State Estimation Method of Thin Membrane Structure using Elastic Wave Propagation

- Research Background

In order to improve the functionality and reliability of a space structure, it is necessary to understand the phenomena occurring in orbit, and to measure the behavior of a membrane space structure in real time and with high accuracy. It is important to develop the technology to do this. Conventionally, the stereo method of point measurement using multiple cameras has been often used for surface shape measurement of space structures. Recently, attention has been paid to the grating projection method of surface measurement in order to measure locally deformed shapes such as wrinkles in detail. However, it is conceivable that an optical method using a camera may not be able to take a satisfactory picture due to the reflection characteristics of the membrane material and the effects of disturbances such as sunlight (Fig.2). Therefore, a wrinkle detection method using elastic wave propagation has been proposed as an alternative and complementary measurement method to this optical method.

- Research Objectives

The purpose of this research is to show the effectiveness of the state estimation method using elastic wave propagation under practical conditions where there are folds and wrinkles on the membrane surface of thin membrane structures.

- Approach Methods

An experimental model in which an actuator for elastic wave excitation and a sensor for elastic wave detection are attached to a thin membrane structure and a fold is made is made. By applying tension to each vertex of the experimental model, the shape of the membrane surface is changed and an elastic wave propagation experiment is performed (Fig.3). In the analysis, the system is constructed by deep learning using the waveform data of elastic waves obtained from the experiment and the image data of the thin membrane structure(Fig.4).

- Research Goals

To construct a system that inputs elastic wave waveform data and outputs image data that estimates the state of the thin membrane structure.

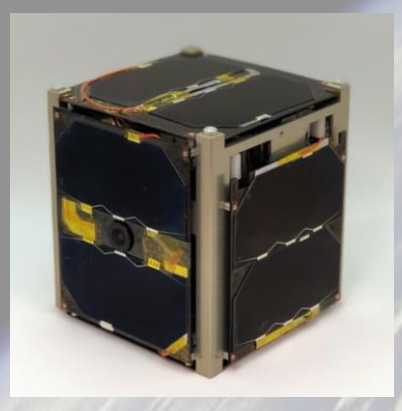
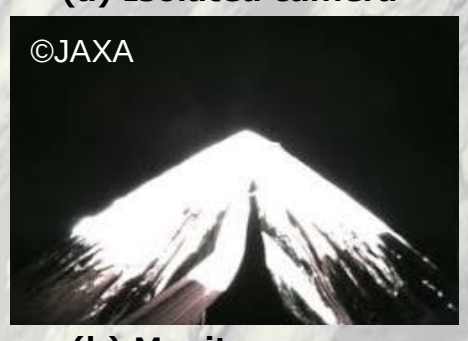


Fig.1 Appearance of NEXUS

(a) Isolated camera



(b) Monitor camera

Fig.2 IKAROS camera images

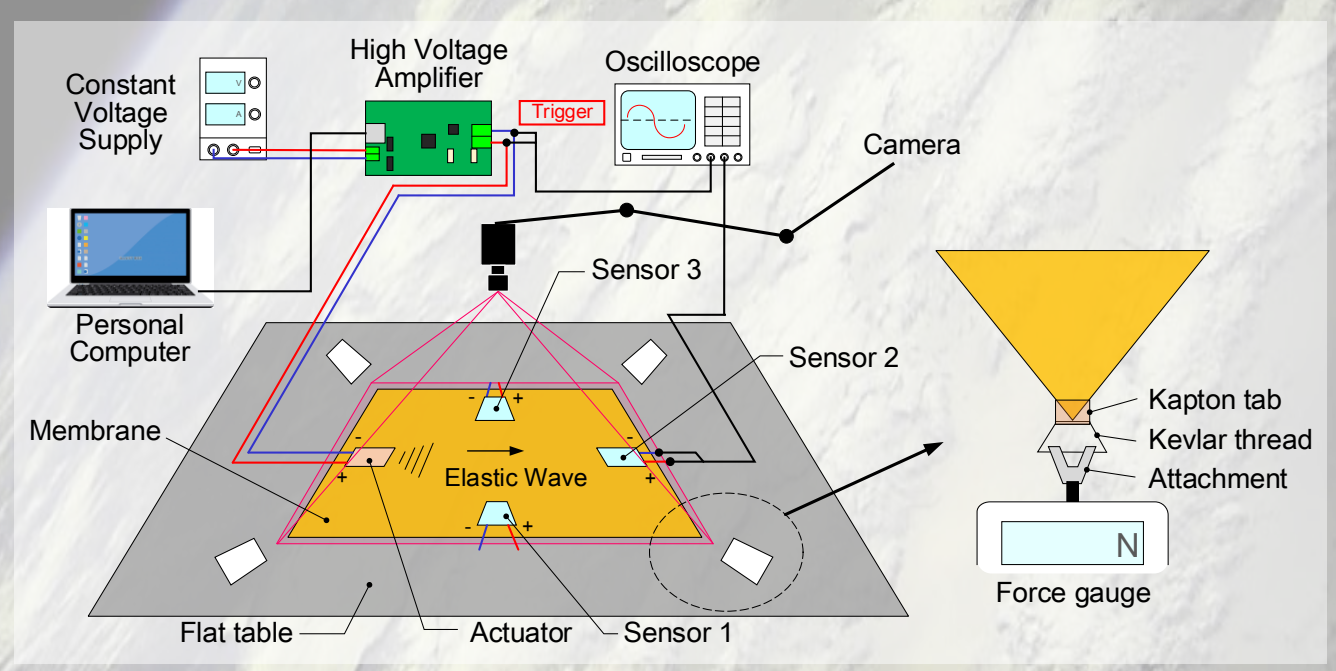


Fig.3 Schematic of experimental equipment

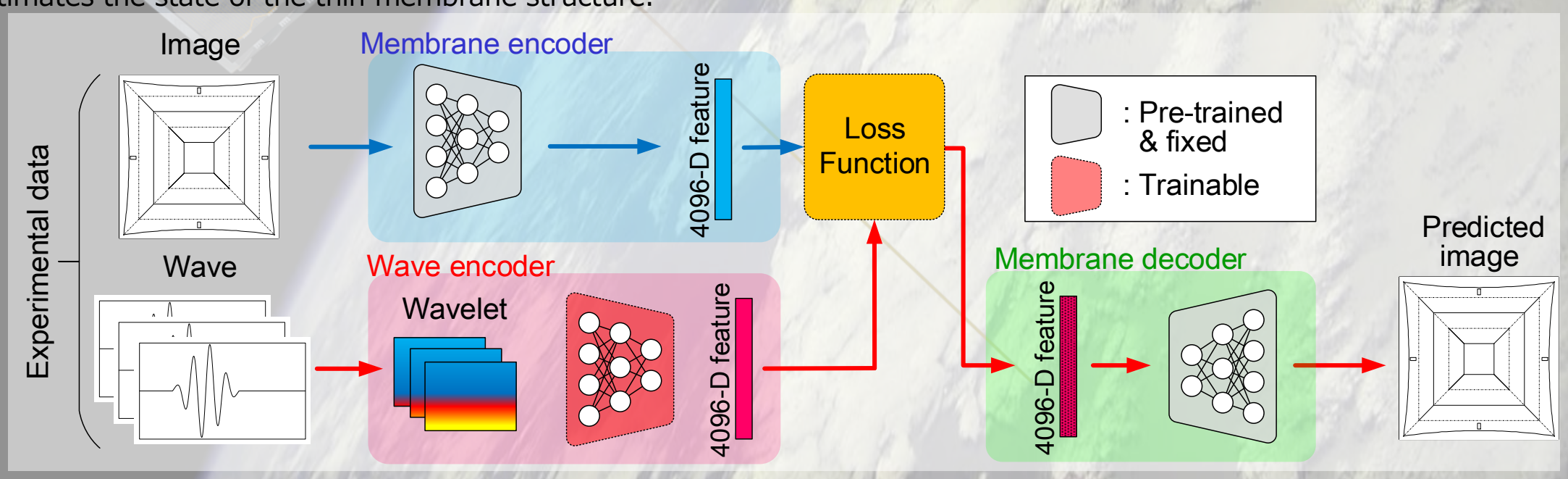


Fig.4 Speech2Face[1] customized model and training pipeline

Reference : [1] T.Oh, T. Dekel, C. Kim, et al.: Speech2Face: Learning the Face Behind a Voice, arXiv: 1905.09773v1, 2019.