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Background

In recent years, the demand for large space structures such as space solar power generation and Starshade is increasing.

Our laboratory has been conducting research on self-deployable membrane truss.

Fig. 1 Previous experiment

If the film surface truss structure can be demonstrated in space, a wide variety of developments such as SSPS, scientific missions, and debris catchers are expected.

Starshade also requires film surface accuracy and transmittance conditions. In addition, in this method, not only the storage is compact, but the nodes must be in the same position when stored. The position of the node is shown in Fig. 4 and subsequent figure.

Purpose

The purpose of research is application to spacecraft. It is used for SSPS, debris catchers, and scientific missions.

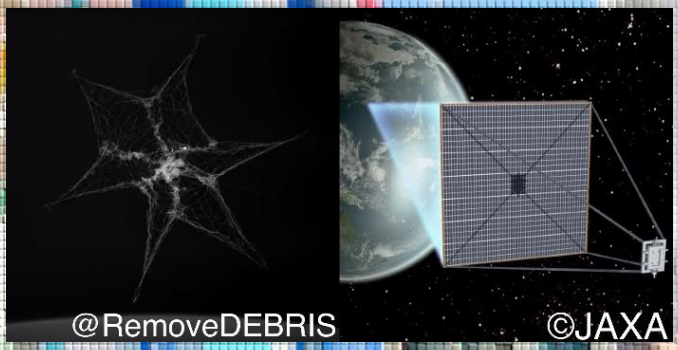

Fig. 2 debris catchers (left), SSPS(right)

In the future, 50m spacecraft will be deployed in space. Toward that, we will conduct an aircraft experiment next year in our laboratory. The membrane of the specimen is selected, stored, and attached.

Fig. 3 Starshade

Progress

First, a membrane that can be used in outer space was selected.

Next, we considered how to fold storage, which is the main theme of research. I tried the folding method that was already used in the space environment. However, the position of the node did not match when storing, so it could not be used.

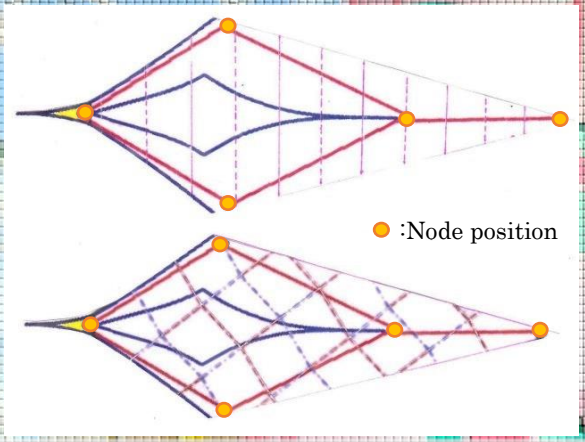

Fig.4 Bellows fold (top), Miura fold (bottom)

Next, priority was given to aligning the nodes, and folding was performed by combining Archimedes spiral folding and bellows folding. I named this "P-fold" and repeated improvements. However, the storage in the height direction did not go well.

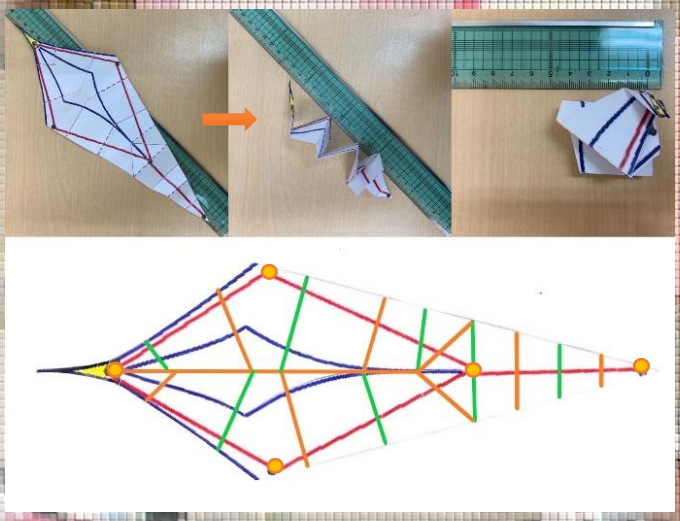

Fig.5 "P-fold"

Finally, I thought about how to fold it with reference to the paper by Professor Natori. Triangles are combined to clear the node position and storage size. This is called "Lily".

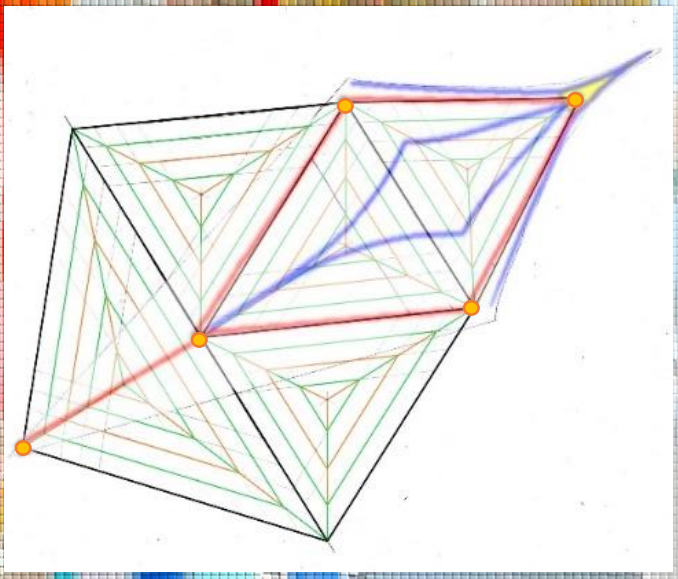

Fig.6 "Lily"

The node position and size at the time of storage are considered to be the best at present, and we are going to conduct an aircraft experiment.

The paper with a total length of 128 cm was stored in $8 \times 5 \times 3$ cm, and it was possible to unfold it by pulling 4 points at the top.

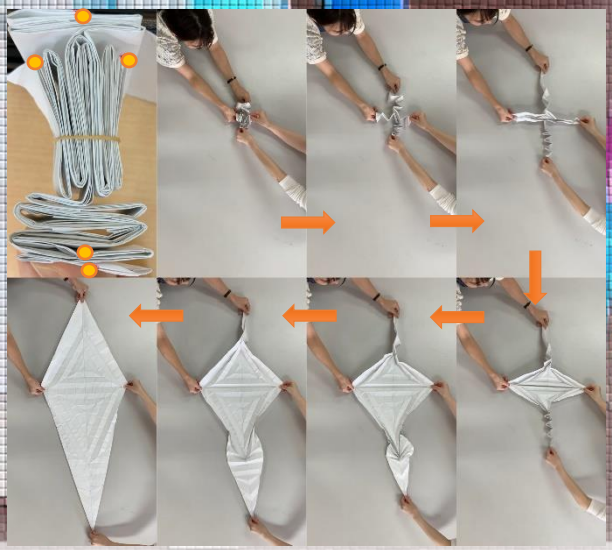

Fig. 7 Development of "Lily"