

Soft Manipulator using Lamina Emergent Torsion Array Including  
Isolated Structure  
孤立化した Lamina Emergent Torsion Array を用いたソフトマニピュ  
レータ

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A soft manipulator is a manipulator consists of soft materials. The softness of soft manipulator becomes possible to realize a manipulator having a high ability to adapt to unknown objects and environments. For instance, when gripping an unknown object of different shapes and sizes, the manipulator itself can flexibly change shape to fit the object during gripping so that it can be gripped gently without damaging the object. In this way, by creating a manipulator with soft materials, it becomes possible to simplify the compliant operation that had required complicated control to be realized by a conventional rigid manipulator. However, it is difficult to measure the deformed shape of soft material using a conventional sensor, so that there is a problem that is difficult to measure the deformation shape of soft manipulators.

The objective of this study is to create a soft manipulator that can accurately measure the deformation state while keeping the compliance which can flexibly correspond even to the unknown object. In order to achieve the objective, in this study, I propose a structure that deforms reversibly from a planar state to a specific and only one deformation shape. The proposed structure is compliant for specific and only deformation but stiff for other deformations. In this study, this property regard as "isolation" of deformation. In order to realize the proposed structures, I improve the Lamina emergent torsion array (LETA) structure. The LETA structure is a structure in which curved deformation is realized by cutting of parallel pattern in hard material. However, it is also known that the LETA structure deforms stretching and twisting deformation in addition to the curved deformation. In order to isolate only the curved deformation, the proposed structure is inserted a thin shell structure in the neutral plane of the LETA structure. By creating a soft manipulator using the proposed structure, the deformation shape can be sensed accurately using a flex sensor, which is an element to measure bending. Additionally, since the deformation of the structure is isolated, the proposed manipulator can be driven using a shape memory alloy with simple expansion and contraction movement.

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