Modular Continuum Manipulator: Analysis and Characterization of Its Basic Module

We present the basic module of a modular continuum arm (soft compliant manipulator for broad applications (SIMBA)). SIMBA is a robotic arm with a hybrid structure, namely a combination of rigid and soft components, which makes the arm highly versatile, dexterous, and robust. These key features are due to the design of its basic module, which is characterized by a three-dimensional workspace with a constant radius around its rotation axis, large and highly repeatable bending, complete rotation, and passive stiffness. We present an extensive analysis and characterization of the basic module of the SIMBA arm in terms of design, fabrication, kinematic model, stiffness, and bending behavior. All the theoretical models presented were validated with empirical results. Our findings show a positional typical error of less than $\approx 6\%$ in module diameter (highly repeatable) with a passive stiffness of 0.8 N/mm ($\approx 1$ kg load). Our aim is to demonstrate that this kind of robotic element can be exploited as an elementary module of a more complex structure, which can be used in any application requiring high directional stiffness but without the need for an active stiffness mechanism, as is the case in daily activities (e.g., door opening, water pouring, obstacle avoidance, and manipulation tasks).

1. For the full content please check the following link: https://www.mdpi.com/2313-7673/3/1/3/htm

References

1. Anand Mishra; Alessio Mondini; Emanuela Del Dottore; Ali Sadeghi; Francesca Tramacere; Barbara Mazzolai; Modular Continuum Manipulator: Analysis and Characterization of Its Basic Module. Biomimetics 2018, 3, 3, 10.3390/biomimetics3010003.

Keywords

continuum manipulator;soft robot;modular arm;compliant structure;large deformation;constant curvature;tendon-driven actuation;kinematic modeling;planar spring;beam theory

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