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Hierarchical compact piezoelectric tripod manipulator based on ribbon-shapedamplification mechanisms

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This paper presents the design and development of a 3-DOF hierarchical compact piezoelectric tripod Manipulator(HCPTM) drvien by linear displacment of three-axis stacked with ribbon-shaped amplification mechanisms with piezoelectric stack actuators. Generally, piezoelectric stack actuators have a wide bandwidth and high strength, but they have a limited strain of about 0.1%. Conventional tripods based on these actuators offer a small workspace while taking up an excessive amount of space. This paper proposes a novel compact tripod parallel manipulator with hierarchical three-axis mechanisms in the form of ribbon-shaped amplification mechanisms based on a bridge-type flexure hinge design. With the ribbon-shaped structure and a hierarchical crisscross series arrangement, the new compact three-axis mechanisms have an effective strain which exceeds 2.3% and can stably operate while withstanding a concentrated load in the actuation direction for the tripod. In particular, the effects of the structural parameters of the amplification mechanism on the performance of the amplification ratio are evaluated. The validation of 3-DOF actuation of the proposed tripod is achieved by means of a commercial finite element (FE) analysis. A prototype of the HCPTM has a workspace with a rotational angle of 1.2° (pitch and roll motion) and linear stroke of 562 µm (heave motion), despite its small size (total height of 56.0mm and radius of 24.3mm) and weight (115g).

Biography

Tae-Won Na received the BS degree in mechanical engineering from Sungkyunkwan University, Suwon, Korea, in 2010. He is currently working toward the M.S. degree in the School of Mechanical, Aerospace and Systems Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea.

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