Research on Deformation of Four-bar Tensegrity Robot

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Abstract

In recent years, the tensegrity structure has been more and more applied to the field of robotics. Applying the tensegrity structure to space exploration and mobile landing has become a research direction concerned by many scholars.

We add diagonal strings to the end planes of the four-bar tensegrity unit. The diagonal strings are used as the driving component, and the oblique strings of the four-bar tensegrity unit are replaced by springs to adapt to length changes of the components when the structure is deformed. We can deform the whole structure through stretching and shortening the diagonal strings in order to complete rotating and moving of the four-bar tensegrity unit. Therefore, the four-bar tensegrity unit can be transformed into the four-tensegrity robot. When prototype of the four-bar tensegrity robot is experimented, we found that two diagonal strings on the same side would interfere each other. In order to solve this problem, we investigated deformation of the four-bar tensegrity robot.

When the diagonal strings are driven to deform the robot, the shape enclosed by the horizontal strings on the same side varies between a square and a diamond. In order to reduce difficulty of the deformation analysis, the angle between the edges of the diamond and its long diagonal is defined. This angle and length of the short diagonal string are used as independent variables to set up expressions of some structural parameters, such as length of the long diagonal, height of the structure and distance between two diagonal strings on the same end plane. Then the newton iteration method is applied to solve deformation process of the robot and the variation law of the structural parameters. Next, according to distance between the two diagonal strings on the same end plane, relative position of the two diagonal strings on the same end plane are determined. Then the ADAMS simulation is applied to verify correctness of the whole theoretical analysis. Finally, the experimental prototype is improved and experimented according to the analysis results.

Reference

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