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Investigation of a tensegrity structure with multiple equilibrium configurations as jumping motion system

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Abstract: Often, the operating range of mobile robots is limited by environmental circumstances like obstacles or gaps. Therefore, an adaptation of the motion principle is required to enable such robots to continue to operate. A jumping motion is a promising approach. This motion type allows to cross gaps or to overcome obstacles where common motion principles which bases on wheels or legs fail. However, especially during landing large forces occur as a consequence of the impact with the ground. This issue encourages the use of compliant tensegrity structures which feature a great shock resistance. In this paper a tensegrity structure with multiple equilibrium configurations is considered. The two-dimensional structure is equipped with two actuators to vary the prestress of the system. The tensegrity structure is in contact to a horizontal plane due to gravity. Two actuation strategies are derived. Beside varying the prestress state of the structure, a jump can be realized by changing the equilibrium configuration. Both actuation strategies and the corresponding motion characteristics are evaluated by numeric simulations. The results emphasize the advantageous properties of tensegrity structures for a jumping motion system. In particular, the multistabilty of the structure allows a simple actuation strategy for a reliable jumping motion.

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