Cross-Section Transformer: An Innovative Foldable Wheeled Robot With Flexible Configuration

Chen, Li Wei (School: Guangzhou Zhixin High School)

Pipeline is a typical complex environment, and pipeline robots greatly improve work efficiency. However, the existing robots have limited forms, and lack of passibility and flexibility. So this study is to explore a robot scheme adapting to complex terrain by flexibly changing the shape and going through large barriers. By innovatively introducing the concepts of virtual and solid cross-sections to characterize existing robots, it shows that the shape of central radial symmetry limits the effective obstacle crossing area. So it formed an idea of variable cross-section to increase the the area by changing the shape of the solid section of the robot. The new three-dimensional folding engineering scheme based on this idea realizes the continuous and flexible change of the solid section with both sides of the its wheel arms. It can be folded in 0-90 degrees on the XZ plane, with height varying in 20-30 cm, and be folded in -80- 80 degrees on the YZ plane with width varying 30-50 cm, which enables it to transform between climbing pipes and moving on the ground at a high speed, running at 5cm/s and 10cm/s respectively. With the combination of program active adjustment and springs passive compression, it can adapt to the diameter of 32-48 cm pipe and the right angle bend pipe and cross the obstacle below 15*25cm. The results show that this scheme has more powerful passibility and flexibility than the existing robot. It can be a fast-moving platform conducting search and rescue missions in complex and confined spaces. More importantly, this robot structure design can be further migrated and integrated into other moving robots, and its variable section structure design idea can inspire more and more effective robot structure innovation design.

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