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A General Kinematic-Based Walking Algorithm of a Hexapod Robot on Irregular Terrain

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Abstract: Developing an algorithm for ensuring a feasible gait of Hexapod Walking Robots (HWRs) poses the challenge of enabling smooth locomotion on uneven terrain, utilizing the mobility of its six legs that alternately make contact with the ground. To this end, a kinematic-based approach is applied that individually takes into account the movements of each leg, while maintaining compatibility with the body's motion through a non-symmetrical tripod gait. Accordingly, the forward kinematics of the robot is established using the Denavit-Hartenberg parameterization and its inverse kinematics is derived using Paul's method. Then, the uneven terrain is represented by elevation differences in a 3D curve trajectory. After that, an algorithm is proposed to ensure the adaptability of the robot's legs with respect to the terrain's shape, namely, the algorithm allows each leg to follow its own trajectory independently. To validate the proposed approach, 3D simulations are conducted using MATLAB software, demonstrating the accuracy and reliability of the purely kinematic approach. The results show that the algorithm enables the HWR to adapt its walking to irregular terrain in various general cases.

Keywords: *Hexapod Walking Robots (HWRs); modeling robots; gait locomotion; tripod gait.*

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