Spine Integration for Quadrupedal Robots

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In this study, we investigate the integration of a flexible spine into existing quadrupedal robots to enhance their adaptability and locomotion in challenging terrains. Drawing inspiration from biological systems, our objective is to develop a jointed flexible body capable of absorbing external forces encountered during locomotion, thereby enabling broader range of movement while also reducing noise on inertial measurement unit (IMU) sensors. Our methodology involves utilizing MATLAB's Simulink and Simscape to conduct force and position analysis, and evaluating the impact of spine incorporation on force absorption and gallop dynamics. This is done by replacing the traditionally rigid body of the robot with a body consisting of a single joint as the center of gravity. This is to strike a balance between flexibility and rigidity, to promote additional handling without losing the control that would come with a completely soft body. Preliminary results suggest promising trends in force mitigation, although further research is needed to develop control strategies to assess and adapt to potential strain on the system. These methods will also be used for mitigating noisy sensor readings and using reinforcement learning techniques to test the robot's adaptation to unpredictable terrain. This research contributes to the underdeveloped topic of bio-inspired spines in robotics, with the focus of refining force absorption mechanisms to enhance sensor readings and overall robot adaptability in challenging environments. These advancements hold potential applications in areas such as space exploration and rescue missions, which would otherwise be too dangerous to explore.