Extraterrestrial Exploration Hexapod With Tactile AI-Based Gait Adjustment

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Extraterrestrial exploration has predominantly employed rover robots due to their proven reliability. Recent research, however, suggests that legged robots, with their superior mobility and agility enabled by adaptive locomotion systems, may offer a more effective solution for navigating extraterrestrial terrains. This study focused on developing a hexapod robot equipped with a tactile AI-based terrain recognition system capable of adjusting its gait accordingly. The development process began with the mechanical design and 3D printing of the robot's components, followed by the integration of a servo motor-powered system. Subsequent programming efforts yielded a variety of gaits tailored to specific environmental challenges and a hybrid gait for enhanced data collection through both tangential (friction) and normal (hardness) force measurements facilitated by a pressure sensor, taking advantage of a tactile AI's superiority in extracting physical force features. A multilayer neural network was then designed to classify the collected tactile data, enabling the robot to predict the type of terrain it encountered and adjust its gait dynamically. Experimental validation was conducted across continuous test fields featuring PVC, cardboard, and sand surfaces, which differ in friction and hardness. The robot demonstrated an 80% success rate in terrain recognition and navigation across 20 trials even with a relatively small dataset, showcasing its potential as a versatile tool for future extraterrestrial missions.

Awards Won:

Fourth Award of $500

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