Adaptive serpentine locomotion of a snake robot involuntarily activated and modified through sensory feedback affected by longitudinal frictional anisotropy

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ABSTRACT

We aim to develop a snake robot that can autonomously slither over terrains with different surface friction, as found in outdoor environments. We build a simple snake robot with a scaled-up ventral scale plate under each segment, based on the property of longitudinal fricti onal anisotropy of a real snake's scales; the robot is driven by central pattern generators (CPGs) with two kinds of sensory feedback. When the effect of ventral friction is fed back to the corresponding CPG via the sensory feedback, it autonomously creates a phase difference between the CPGs, which is initially kept in phase by a hard-wired CPG network, eventually resulting in a spontaneous serpentine gait with good propulsion. In addition, when we allow the snake robot to move on a worn-out carpet with partially different friction levels, the robot demonstrates an adaptive locomotion to slither by autonomously adjusting the cycle, phase difference, and amplitude according to the different surface frictions. We hope that the autonomous adjustment differently occurs in each joint while slithering in outdoor environments where different contact frictions occur on different body segments.

KEYWORDS

Snake robots; Robot sensing systems; Friction; Muscles; Anisotropic magnetoresistance; Neurons

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