The Role of Leg Differentiation in Hexapedal Running

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ABSTRACT

Designing a robot that can autonomously traverse a variety of terrain types is difficult. For this reason, one may refer to nature for inspiration and produce robots that mimic biological organisms. RHex is one such device, a six-legged breadbox-sized robot whose design resembles that of a cockroach. Building a robot that mimics a living creature carries additional advantages beyond locomotive stability. For instance, mathematical models that describe animal walking and running can be applied to the device, so an entire existing body of analysis can be used to characterize the robot's movement, saving time and increasing intuitive understanding. One such model, the spring-loaded inverted pendulum (or SLIP) model for animal running and hopping, has been successfully applied to RHex's forward motion. However, like many animals, RHex deviates from this model in that it exhibits an oscillatory side-to-side motion. The goal of the current research is to characterize this swaying motion, describe it with a simple model, and use the model to explain how to compensate for the transverse motion. To characterize the swaying motion, a force plate sensor will be used to measure the ground reaction forces from each of the robot's legs and high-speed video of the robot's gait will be recorded. Following this, a simple mathematical model of the motion will be created. Then, using information from the model, aspects of the robot's gait and leg composition will be altered to compensate for the swaying motion, ideally eliminating it entirely. Finally, observations will record the effect that this modification has had on the efficiency and stability of the robot's motion.