Identification of a Bipedal Robot with a Compliant Drivetrain

PARAMETER ESTIMATION FOR CONTROL DESIGN

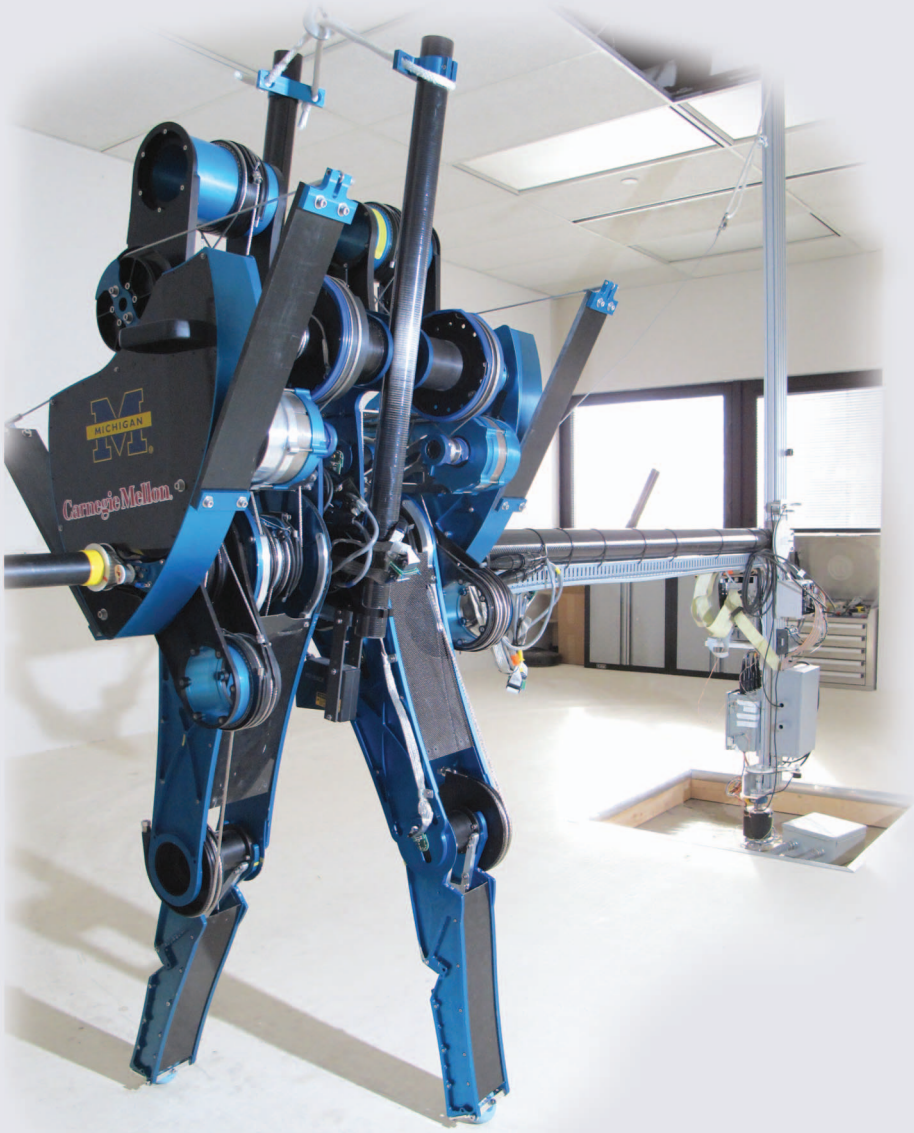

PHOTO BY HAE-WON PARK AND KOUSHIL SREENATH

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Research in bipedal robotics aims to design machines with the speed, stability, agility, and energetic efficiency of a human. While no machine built today realizes the union of these attributes, several robots demonstrate one or more of them. The Cornell biped is designed to be highly energy efficient [1]. This robot walks with a dimensionless mechanical-transport cost c_{mt} of 0.055; the corresponding efficiency for a typical human is 0.05. The down side of this achievement is that the robot can walk on only flat ground; it trips and falls in the presence of ground variations of a few millimeters. The Planar biped, which excels at agility, can run stably on one or two legs, hop up and down stairs, and can bound over piles of blocks, but does not walk well [2]–[4]. This robot is inefficient due to its pneumatic and hydraulic actuation. Moreover, the physical principles that underlie its mechanical design and control system are difficult to generalize to other machines. The bipedal robot Rabbit exhibits

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