Award Abstract #1566463

CRII: RI: Energy Effective and Versatile Bipedal Robots Using Event-Based Switching Between Parameterized Steady-State Controllers

NSF Org:	IIS Div Of Information & Intelligent Systems
Initial Amendment Date:	March 18, 2016
Latest Amendment Date:	March 18, 2016
Award Number:	1566463
Award Instrument:	Standard Grant
Program Manager:	Reid Simmons IIS Div Of Information & Intelligent Systems CSE Direct For Computer & Info Scie & Enginr
Start Date:	September 1, 2016
End Date:	August 31, 2018 (Estimated)
Awarded Amount to Date:	$159,024.00
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NSF Program(s):	CRII CISE Research Initiation
Program Reference Code(s):	7495, 8228
Program Element Code(s):	026Y

ABSTRACT

Bipedal robots, unlike humans, are either energy-effective or versatile but not both at the same time. For example, the Honda ASIMO can walk over stairs and navigate around obstacles but needs to be recharged about every hour or so. On the other hand, robots inspired by passive dynamics use trivial amounts of energy to move but are limited to a single speed and step length. This project develops a theory that fills this knowledge gap by enabling bipedal robots to make informed decisions about what strategy to follow given a particular circumstance. For example, on rough terrains, a robot may have to decide to expend more energy in order to maximize stability while, in cases where the terrain is flat and regular, the same robot can decide to use its most energy-efficient gait while paying little heed to stability.

There is a need to develop a theory that would simultaneously enable improved

performance metrics for the energy-efficiency and versatility of bipedal robots. The instability of bipedal robots, due to their inverted pendulum like nature, makes this challenge even greater; hence, metrics for balance and stability also need to be met simultaneously. The gap in knowledge is that, it is unclear how to enable bipedal robots to satisfy all these performance metrics, some of which can actually be conflicting (e.g., energy-efficiency trade-offs with stability).

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