The Development of an IGBT Health Monitoring Framework

Michael Wu
Electrical and Computer Engineering, UIUC

IGBT deployment has become more widespread due to their high voltage and high current capabilities. Typical applications range from transportation electrification to renewable resource implementation. However, IGBT’s are some of the more delicate components in such high-power systems. Indeed, IGBT failures can bring severe economic repercussions. As such, the development of an online health monitoring system to ensure proper power module operations and predict its remaining life is important. We report on a framework for the design of an IGBT health monitoring system. The presentation focuses on a key element of framework – the thermal model. We discuss such a model for an IGBT power module in a 3-phase, 2-level inverter that can accurately estimate junction temperature. The temperature data is used to evaluate the current health and remaining life of a power module. We discuss the key requirements of the hardware implementation in terms of its ability to withstand high voltages and currents to accurately measure on-state saturation voltage and collector current to determine the power dissipation in the power module.

A Distributed, Spring-Aided, Vertical, Electromechanical Spine for Bio-Inspired Robots

Bonhyun Ku
Electrical and Computer Engineering, UIUC

Abstract

Biological mechanisms are incorporated in mobile robots to interact with their environments. Although today’s biologically-inspired robots perform well, their performance is limited by the absence of a spine. A vertebrate spine provides agility together with a wide range of motion, balance and efficiency. In order to build a spine in vertical plane, gravity must be taken into account to explicitly have lower modules with the longer moment arm lengths. We present an approach to create a spring-aided, electromechanical actuator for a vertical robotic spine. We deploy different spring rates and explicitly take account of the gravity effects in the vertical plane. We derive the distributed spring rates through the spine that we implement into a virtual torsion-spring mechanism using linear-extension springs. The elastic energy stored in springs is used to improve the torque capability. We stack 6 modules, one on top of another, to form a spine. Each module consists of an E-shaped core, two coils and the embedded power electronics. The actuator utilizes electromagnetic force induced by the coil currents. We discuss the simulation and experimental results to validate the ability of the electromechanical spine to reproduce animal-like motions in vertical plane.