Title:

Power Management Algorithms using Network Coding and Neural Networks for Internet of Thing (IoT) Platforms.

Abstract:

The Internet of Things (IoT) is a platform that connects various electronic systems such as home appliances, vehicles, and medical devices through wired or wireless communica- tions. Without recharging the battery of sensors and mobile systems in IoT networks, their performance and usage time are limited. In order to improve availability with finite battery energy, power management is used to conserve the energy dissipation of sensor networks and mobile systems. This dissertation addresses power management in two categories of systems within IoT: wireless sensor networks (WSNs) and electric vehicles (EVs).

For power management in WSNs, this dissertation develops an algorithm using network coding (NC). When one sender transmits multiple packets to different receivers in a WSN, a NC algorithm reduces transmissions between the sender and the receivers by encoding many packets into one packet. Consequently, the total communication energy between them is decreased. For further study about real energy gains generated by NC algorithms, we develop a wireless testbed by using mobile devices. Consequently, by varying different network variables such as transmission range of a sender or the number of receivers in the testbed network, we discover network conditions where communication energy created by NC algorithms is improved. However, NC algorithms spend operational energy overheads for algorithm execution, encoding, and decoding. Hence, our research also shows the threshold conditions where the energy savings created by the NC algorithms are larger than the energy overheads with consideration of communication variables or algorithm complexity in order to identify opportunities for energy savings.

For power management of EVs, this dissertation develops an energy-efficient algorithm using neural networks which can be used with power management of electric vehicles (EVs). The power management saves energy consumption of EVs’ electronic control system by selectively activating electronic control units (ECUs) in the system. However, the energy savings generated by the power management could be less than the energy overheads used for the selective ECU activation. Our algorithm trains neural networks about experienced events where energy overheads were greater than energy savings. The neural networks forecast energy-inefficient events and conserve the consumption of energy overheads based on the predicted events. In the simulation results on real driving datasets, the algorithm improves the energy dissipation of the electronic control system by 5% to 7%.