ETH zürich

Chair of Intelligent Maintenance Systems

Master Thesis in Machine Learning for Intelligent Maintenance:

Degradation-awareness Load allocation for multi-battery systems with meta reinforcement learning

Motivation:

Multi-energy source configurations such as multi-battery, batteries combined with an ultracapacitor, or batteries with fuel cell have recently become ubiquitous providing lightweight and energy-efficient applications for many different implementations including consumer electronics, embedded systems, and hybrid vehicles. Prolonging the discharge cycle (and thereby increasing the range of hybrid vehicles, for example) and the lifetimes of the energy systems in the meantime has been a longstanding challenge.

Currently applied more sophisticated power management strategies (than the equal power allocation) are predominantly rule-based and optimization-based. There are several limitations to these approaches, such as extensive prior knowledge needed, scalability, high computational cost or being vulnerable to uncertainties and changes in the schedule of the power profiles. On the other hand, the learning-based method such as reinforcement learning-based strategy has also been investigated. However, it is a limiting and simple case with discretized state and action space, which is not general enough. Furthermore, the approaches mentioned above usually require processed features, for example in batteries such as SoC or SoH information is needed. It is still challenging to distribute the power in an end-to-end way, with limited or raw information such as real-time voltage-current information.

Task description:

In our previous work, we developed a general RL-based framework for multi-battery systems, which shows considerable scalability and transferability. However, battery discharge dynamics is heavily influenced by the internal degradation. Without considering the battery degradation, the policy deployed may perform below the expectation. In this work, we take the internal degradation into account. By using meta-reinforcement learning to capture the latent information about the system dynamics and make the framework more feasible to real scenarios.

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