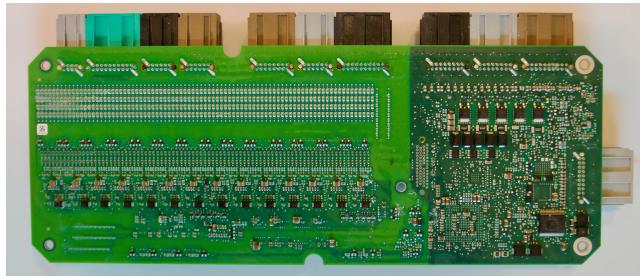




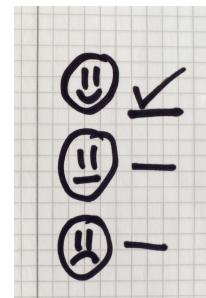
Introduction and BMS functionality

- This specialization investigates the proper management and control of battery packs, usually comprising many cells
- The methods and algorithms we discuss would typically be implemented by a battery-management system or BMS, which is an embedded system (purpose-built electronics plus processing to enable a specific application).



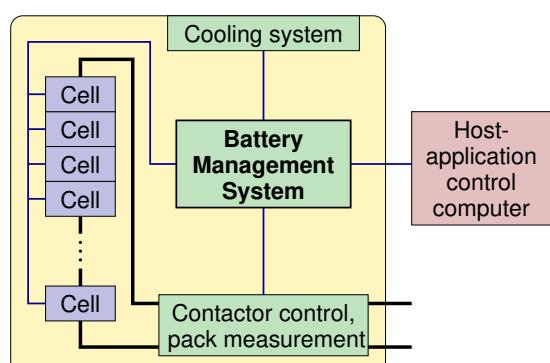
Why do we need a BMS?

- A BMS has the following priorities:
 - Protects safety of the operator of the host application; detects unsafe operating conditions and responds
 - Protects cells of battery from damage in abuse/failure cases
 - Prolongs life of battery (normal operating cases)
 - Maintains battery in a state in which it can fulfill its functional design requirements
 - Informs the host-application control computer how to make the best use of the pack **right now** (e.g., power limits), control charger, etc.



General BMS functionality (1 of 5)

- BMS is interconnected with all battery-pack components and with host-application control computer
- Functionality can be broken down into several categories:
 1. **Sensing and high-voltage control**
 - Measure voltage, current, temperature; control contactor, pre-charge; ground-fault detection, thermal management



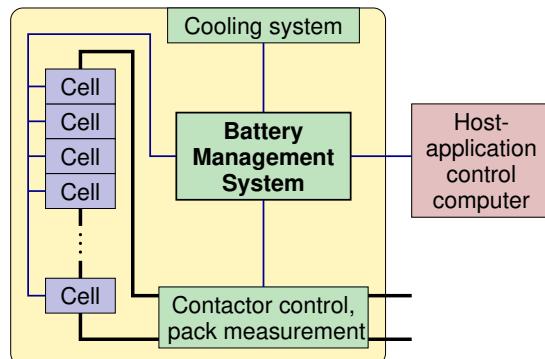


General BMS functionality (2 of 5)

- BMS is interconnected with all battery-pack components and with host-application control computer
- Functionality can be broken down into several categories:

2. ***Protection against***

- Over-charge, over-discharge, over-current, short circuit, extreme temperatures

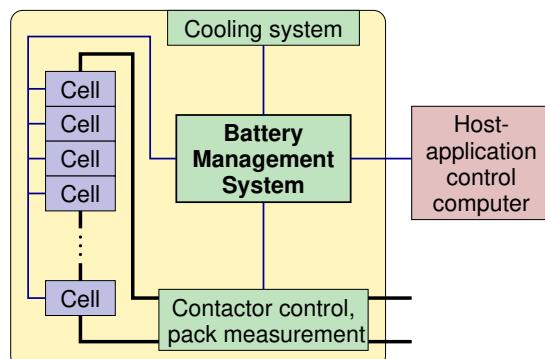


General BMS functionality (3 of 5)

- BMS is interconnected with all battery-pack components and with host-application control computer
- Functionality can be broken down into several categories:

3. ***Interface***

- Range estimation, communications, data recording, reporting

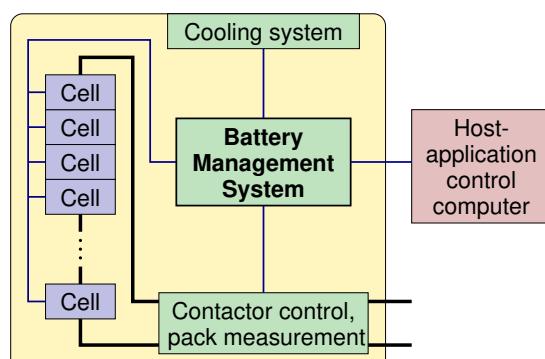


General BMS functionality (4 of 5)

- BMS is interconnected with all battery-pack components and with host-application control computer
- Functionality can be broken down into several categories:

4. ***Performance management***

- State-of-charge (SOC) estimation, power-limit computation, balance/equalize cells



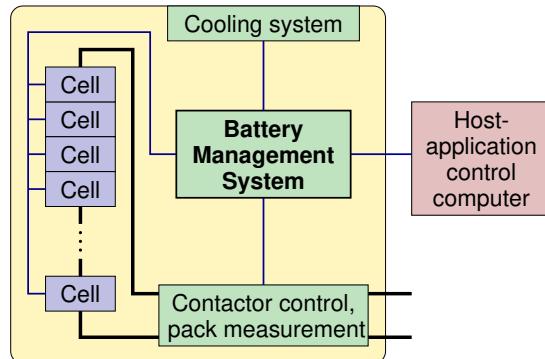


General BMS functionality (5 of 5)

- BMS is interconnected with all battery-pack components and with host-application control computer
- Functionality can be broken down into several categories:

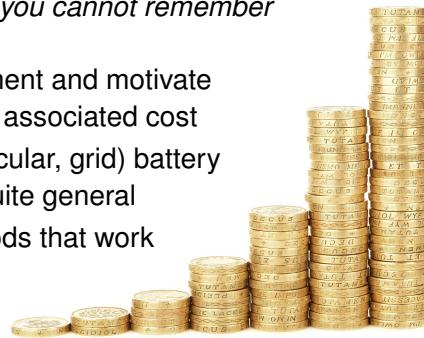
5. Diagnostics

- Abuse detection, state-of-health (SOH) estimation, state-of-life (SOL) estimation



The issue of cost

- There is a cost associated with battery management, so not all applications implement all features
- Rule of thumb: *Your battery is “cheap enough” if you cannot remember when you replaced it last*
 - Larger battery packs represent greater investment and motivate better battery management, even if there is an associated cost
 - This specialization focuses on large (e.g., vehicular, grid) battery packs although the methods we discuss are quite general
 - That is, we will investigate sophisticated methods that work well in all scenarios, but may not be justifiable economically in every case



Summary

- A BMS is an embedded system that protects safety host-application operator, protects battery from abuse, prolong battery life, maintains battery in a functional state, and informs host application how to make the best use of the pack right now
- The BMS functional requirements fall into five general categories
 1. Sensing, high-voltage control
 2. Protection
 3. Interface
 4. Performance management
 5. Diagnostics
- We will look at these requirements in order over the next lessons
- We also noted that there are different levels of sophistication in how a BMS works: our focus is on advanced methods that may have higher cost, but give better results



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