**Advanced Battery Management System (ABMS)**

### Benefits of ABMS

- **Performance Benefits**
  - Reduce cost of batteries > 25% by increasing the envelope of battery operation
  - Reduce charge time by more than 50% to enable higher penetration of EVs

### Validation of BMS performance

- Test 1: Standard BMS
  - Large Pack
  - Small Pack

- Test 2: Advanced-BMS
  - Larger Pack
  - Smaller Pack

### Technology/Concept behind ABMS

- **State-of-the-art BMS**
  - Surface temp.
  - V=cell voltage
  - ECM based limits of battery operation
  - State-of-the-art BMS

- **Advanced BMS**
  - State-of-the-art
  - Proposed
  - Internal states

- **Performance Benefits**
  - State-of-the-art BMS
  - Proposed

- **Performance Targets**
  - Metric: Cost of battery pack
  - State of the Art: $10,000
  - Proposed: $7,500

### Electrochemical model validation

- Validate internal states

### Optimal charging strategy

- Design optimal control algorithms
- Validate charging strategy

### State and parameter estimators

### Design optimal control algorithm

- BMW

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