**EV Battery Temperature Estimation**

**Heilmeier Questions**

**What are you trying to do? Articulate your objectives using absolutely no jargon.**

The objective of this project is to predict the core (internal) temperature of an electric vehicle (EV) battery pack, given standard a set of measurements from sensors on-board the EV. Due to the large size of EV battery packs, core temperature cannot be directly measured without embedding expensive sensors inside the battery pack. However, core temperature knowledge is critical for ensuring the safety of the vehicle and passengers, thereby motivating the prediction (regression) problem.

**How is it done today, and what are the limits of current practice?**

Core temperature is not estimated in EVs today. Instead, highly conservative limits are imposed on charging/discharging currents to avoid raising the battery temperature into unsafe ranges (as estimated by heuristic methods). The battery pack’s case/external temperature is monitored, but this measurement is meaningless for preventing catastrophic failure.

**Background:** The most common failure mode for EV batteries (and smartphone batteries, e.g. Samsung) is called thermal runaway, which is a vicious cycle triggered by a spike in core temperature. Battery temperature then increases exponentially, ultimately resulting in explosion and emission of toxic chemical compounds. Since the battery core temperature and case/external temperature have a causal relationship (rise in core temperature leads to rise in case/external temperature), any corrective actions taken on the basis of case/external temperature measurements are usually either (i) too cautions, or (ii) too late.

**What is new in your approach and why do you think it will be successful?**

In the research community, estimation of battery temperature using current/voltage measurement has been performed, but on static batteries, using temperature chambers to set battery temperature. It remains to be seen whether battery temperature can be estimated on-line, when the vehicle is in motion and when the battery is under load (e.g. powering traction motors or being charged via regenerative braking). We will use measurement data collected during vehicle motion to estimate temperature on-line, which has not been done before.

**Who cares? If you are successful, what difference will it make?**

The auto industry! Estimating core temperature accurately will allow auto manufacturers to operate batteries less conservatively, and ensure safety of the vehicle and its passengers.

**What are the risks?**

Conclusions in this study may be limited by the available data. The work is also novel, so it is possible (but unlikely) that core temperature cannot be estimated well.

**How much will it cost?**

$0

**How long will it take?**

One semester

**What are the mid-term and final “exams” to check for success?**

1. Correlations between temperature and chosen features during exploratory data analysis
2. We will implement a variety of prediction models, so intermediate prediction results will be available

**Dataset**

<https://ieee-dataport.org/open-access/battery-and-heating-data-real-driving-cycles>

**Unsupervised + Supervised Learning Components**

**Unsupervised:** Dimensionality reduction (PCA) will be useful for selecting/designing informative features

**Supervised:** Any predictive model is supervised. We can try many – various regression models, neural networks, etc.