Huawei 2024 Nuremberg Tech Arena

"Lithium-Ion Battery State of Charge Challenge" Guidelines

Challenge description:

Lithium-ion batteries **are the backbone of a secure, robust, and sustainable energy system.**
Ensuring their stable and efficient operation requires continuous advancements and engineering innovations. One critical aspect for efficient battery operation is the **State of Charge** (SoC) estimation, vital for optimizing battery performance.

The competitors are invited to develop a **robust algorithm to estimate the lithium iron phosphate battery state of charge.**

Basic requirements to compete:

- Only students from EU countries are allowed to participate
- Participants should have an adequate understanding of lithium-ion battery technology and its operational concepts.
- The developed algorithm must be implemented using Python with available open-source libraries.

Teams creation:

- After registration, participants should create teams via the slack community.
- Each team should consist of *1 to 3 participants*.
- Each team will receive an invitation email to the platform with further information and login credentials to the submission platform.

Preliminary Phase 16th September to 10th November:

When the preliminary competition opens, the teams will be able to download the required data to start building their algorithms. The data are

- **HPPC Data (Hybrid Pulse Power Characterization)**: a set of discharge-charge pulses, applied to a battery at different states of charge (SOC) and at a given temperature.
- **OCV SOC Data (Open Circuit Voltage vs. State of Charge)**: Provide the needed data set to implement   relationship between the SOC and OCV
- **Real Operation Data**: Define real operational scenarios, including the real SoC values under different load profiles.

Goal:

Develop an algorithm for Optimization: Try to minimize the the error between the estimated SOC and the real SOc on the real operation data

From 14th October: Participants will be invited to set up their codes on the cloud environment (supported accounts will be created for the teams).
Each team should run their codes and the Huawei Team will possibly invite you to a virtual meeting to discuss the solution.

Submission on the platform:
You will receive an email with your login details.
Please upload/submit a **.ZIP file** containing the **challenge code answer:**
Rules:
1. The ZIP file can't be >10MB;
2. Its internal file architecture must contain the following files (but not limited to those files).
   ● **Readme.txt** (should contain a high-level description of the code)
   ● **Requirements.txt** (A list of all necessary Python libraries, including their versions)
   ● **main.py** (the main python entry point, executing it should load a test.csv file and generate the out.csv file)
   ● **one .ppt file** (any name) (should be a PowerPoint file describing the team members and the developed approaches, with a theoretical maximum of 10 slides)
3. The ZIP filename will have the name format generated :
   teamid_ddmmyyyy_Vx.zip (where team id is the team's id, ddmmyyyy is the submission date, and Vx is the version number).

Base of code: We will follow PEP 8 – Style Guide for Python Code as the coding standard for this project, Python Version 3 at least.

By 10th November:
Each team must submit their algorithm according to the submission requirements before the preliminary competition deadline.

11th November -23rd November: Evaluation Phase
● The Huawei technical committee will be responsible for reviewing and evaluating the developed algorithms.

● The *evaluation criteria* will include:
   o **Maximum Absolute Error (MaxAE):** Measuring the largest absolute error in state of charge estimation.
   o **Root Mean Square Error (RMSE):** Assessing the overall accuracy of the algorithm by calculating the square root of the mean squared errors.

o **Calculation Efficiency:** Evaluating the computational efficiency and speed of the algorithm.
o **Transient Convergence:** Assessing how quickly and accurately the algorithm converges during transient conditions.
o **Documentation and Presentation:** Judging the clarity and thoroughness of the documentation, as well as the quality of the final presentation.

November 25th: **Announcement of 10 finalist teams**
Evaluation results will be announced online on the competition website after finishing the first evaluation.

November 25th to December 15th: Final Competition

- Ten teams will advance to the final competition based on the evaluation results.
- Additional testing scenarios will be provided to the ten teams, and they will have additional time to enhance their algorithms.
- A final evaluation will be conducted at the end of the two-week period.
- Competitors will be invited to present their approaches and results at the final ceremony on **19th December 2024 in Huawei's Offices in Nuremberg**.
- The 6 winning teams will be announced at the final ceremony.