AI help?

AI in Electric Vehicles' Thermal Management

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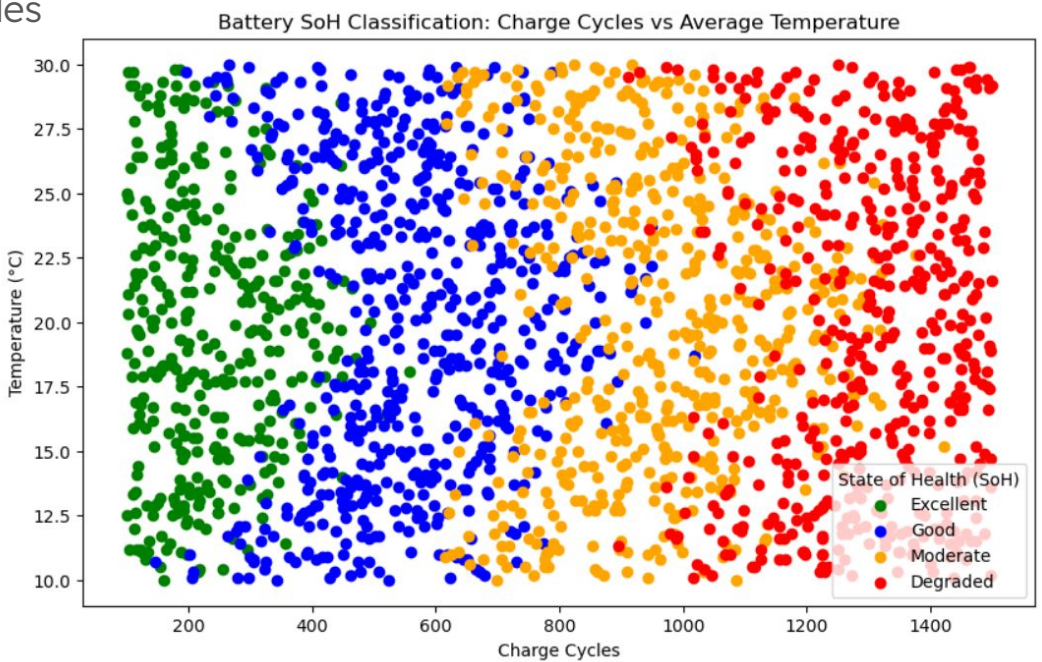
ai forum UTCN

Battery State-of-Health - influence

- Factors that influence battery SoH
  - Battery type (geometry, chemistry, size)
  - Number of charge-discharge cycles
  - Average operating and even storage temperature
  - Lowest and highest operating temperatures ever recorded
  - Lowest ever State-of-Charge
  - Frequency of deep discharges
  - Average State-of-Charge when put to charge
  - Average charging and discharging rates
  - Age etc.



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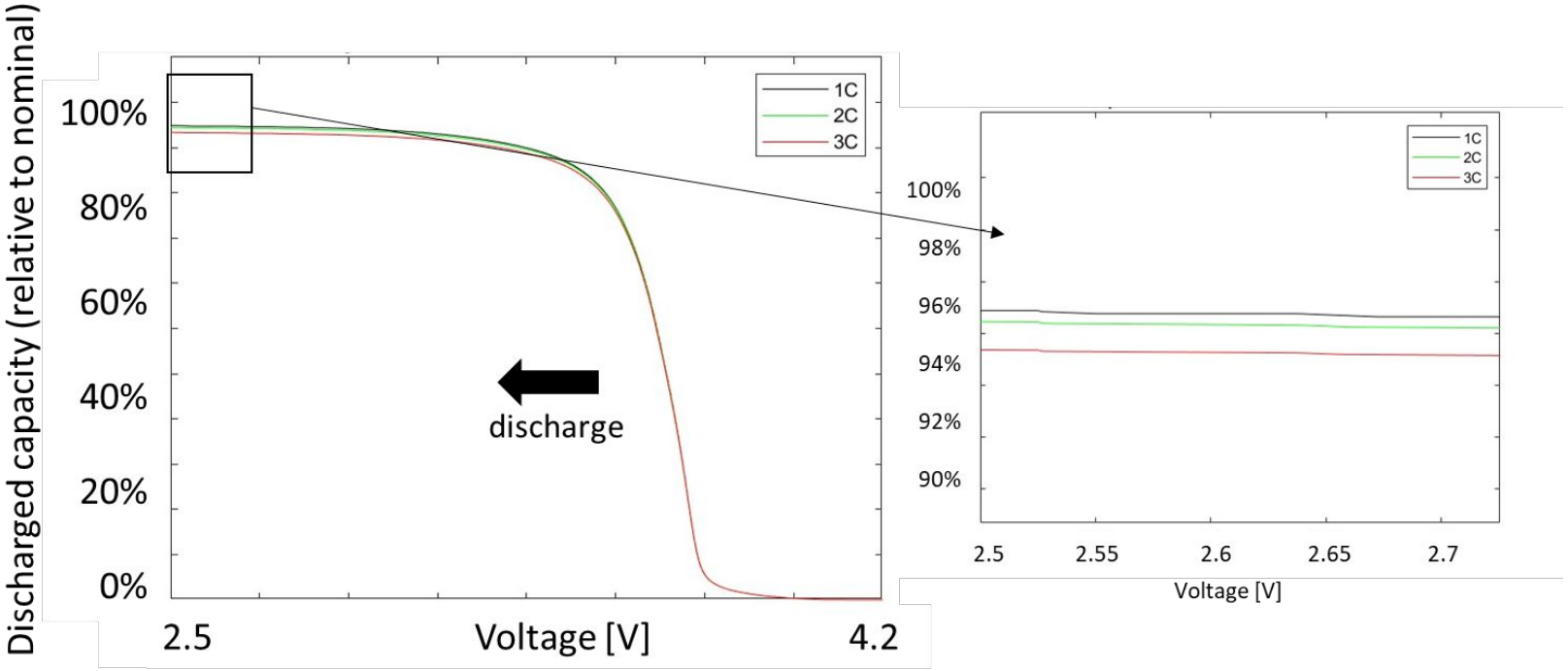
Battery State-of-Health – graphical approach

- dQ/dU graphical representations are already used for the SoH evaluation



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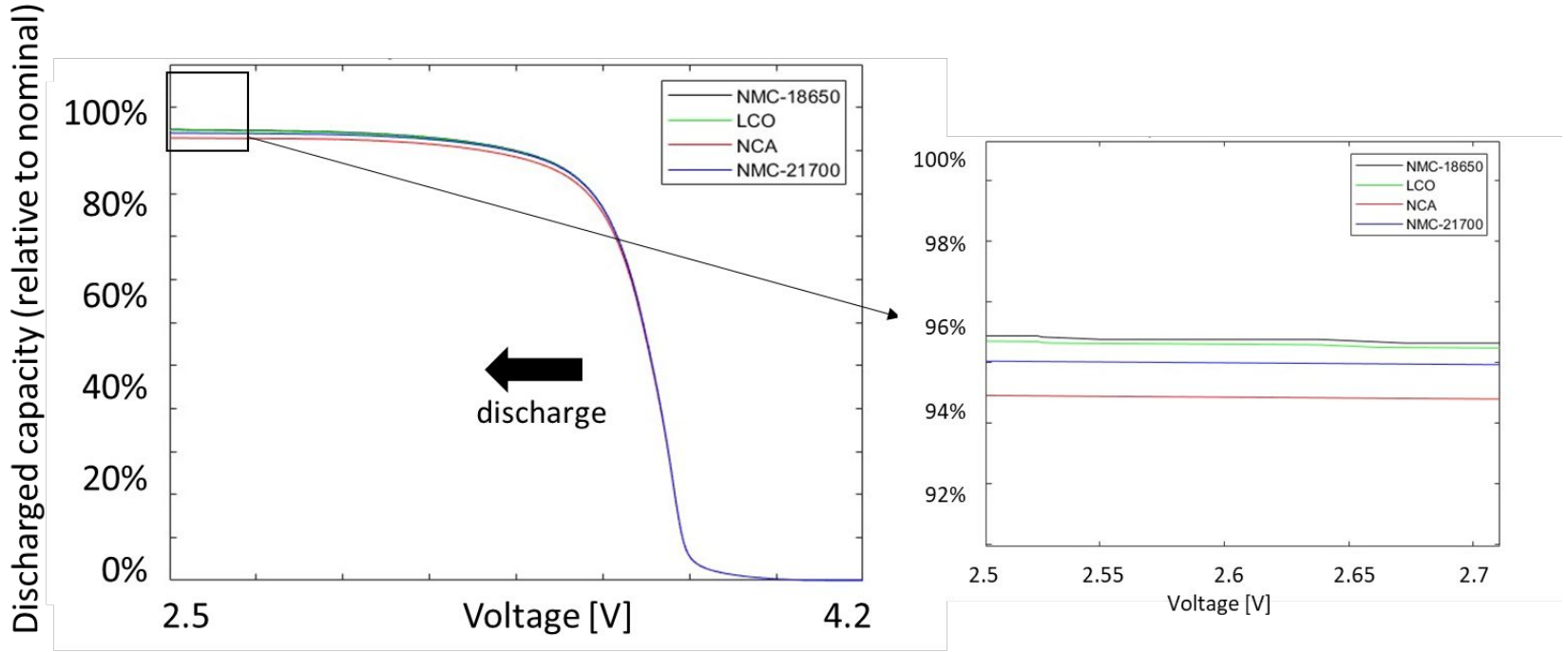
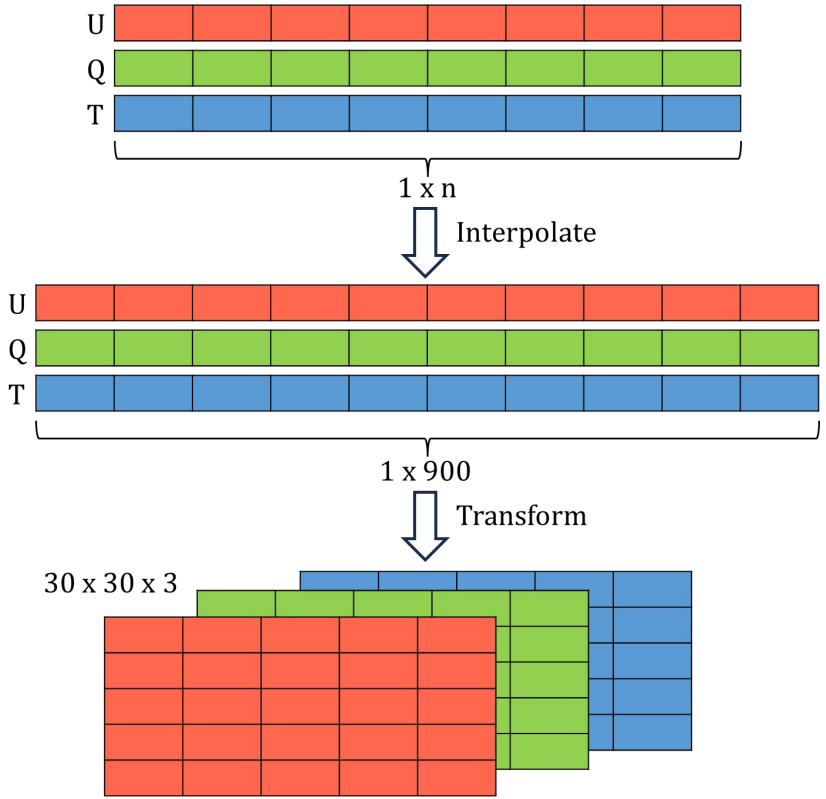
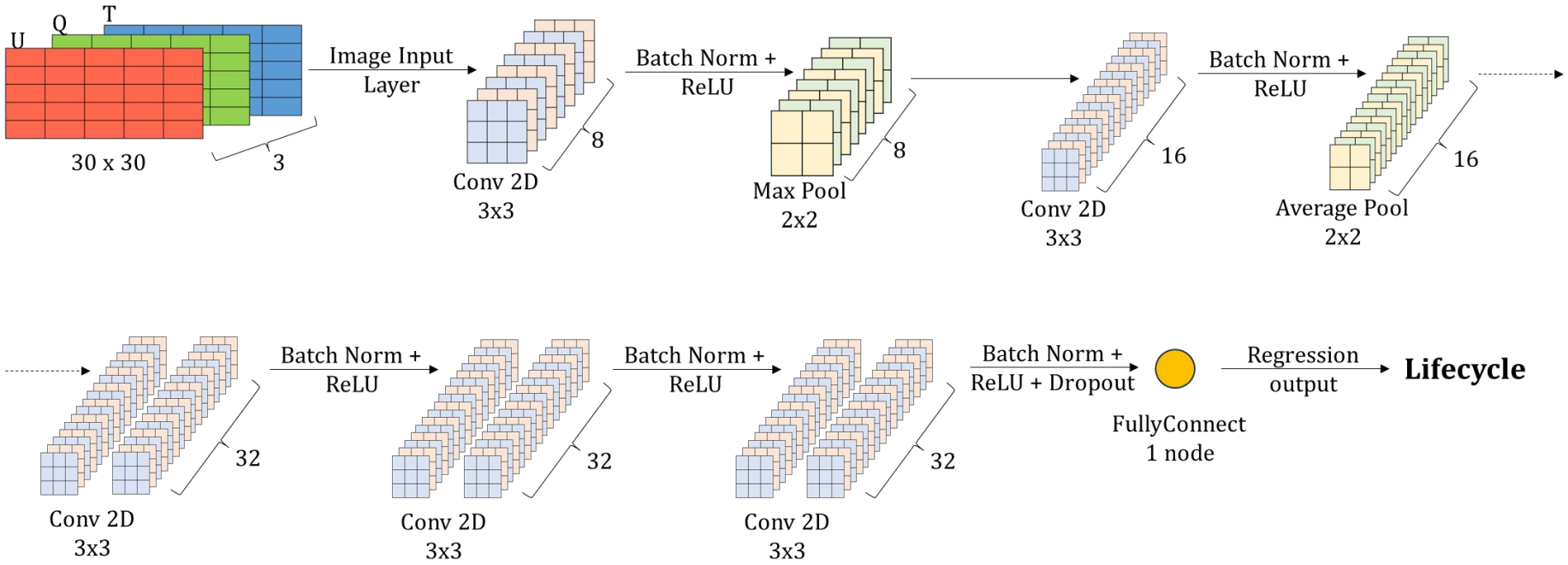


Battery SoH – data preprocessing

- Temperature recordings are added to form 3D matrices for each measurement
  - Convolution can be applied with the aim of detecting patterns between neighboring columns



Battery SoH – CNN architecture



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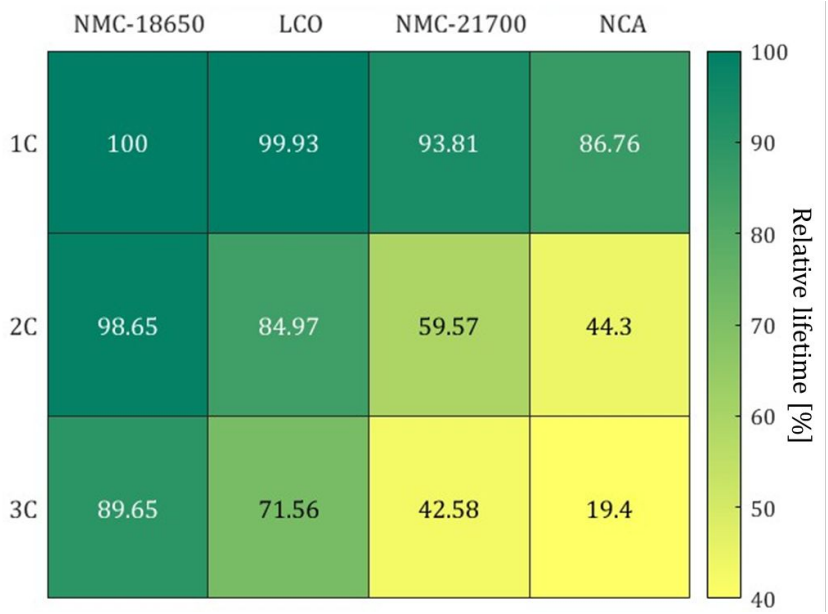
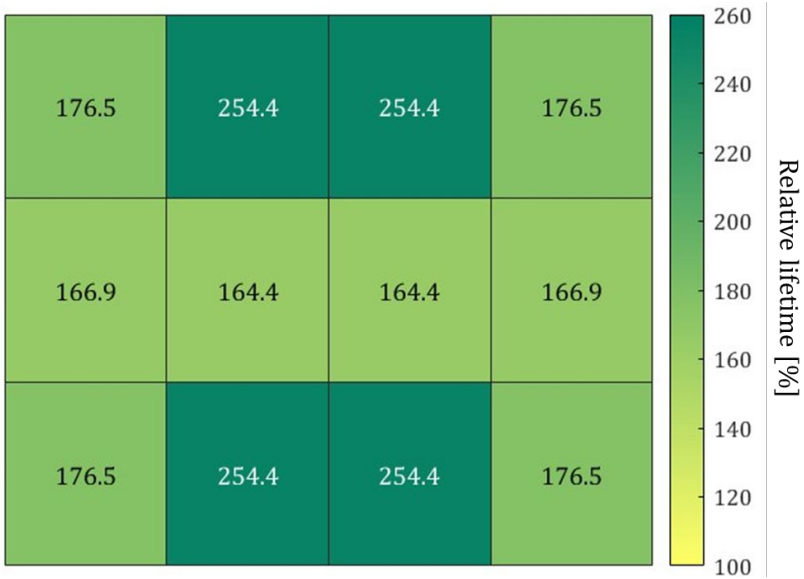
Battery SoH and lifetime estimation

Results for different battery types at different discharge rates



Results for a battery module with local cooling



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Battery SoH and lifetime estimation

Possible development directions

- Increase the number of features
- Detect patterns between all the factors that influence battery SoH and lifetime
- Optimize thermal management control algorithms
- Send notifications to the EV users about habits that could slow down their battery's degradation

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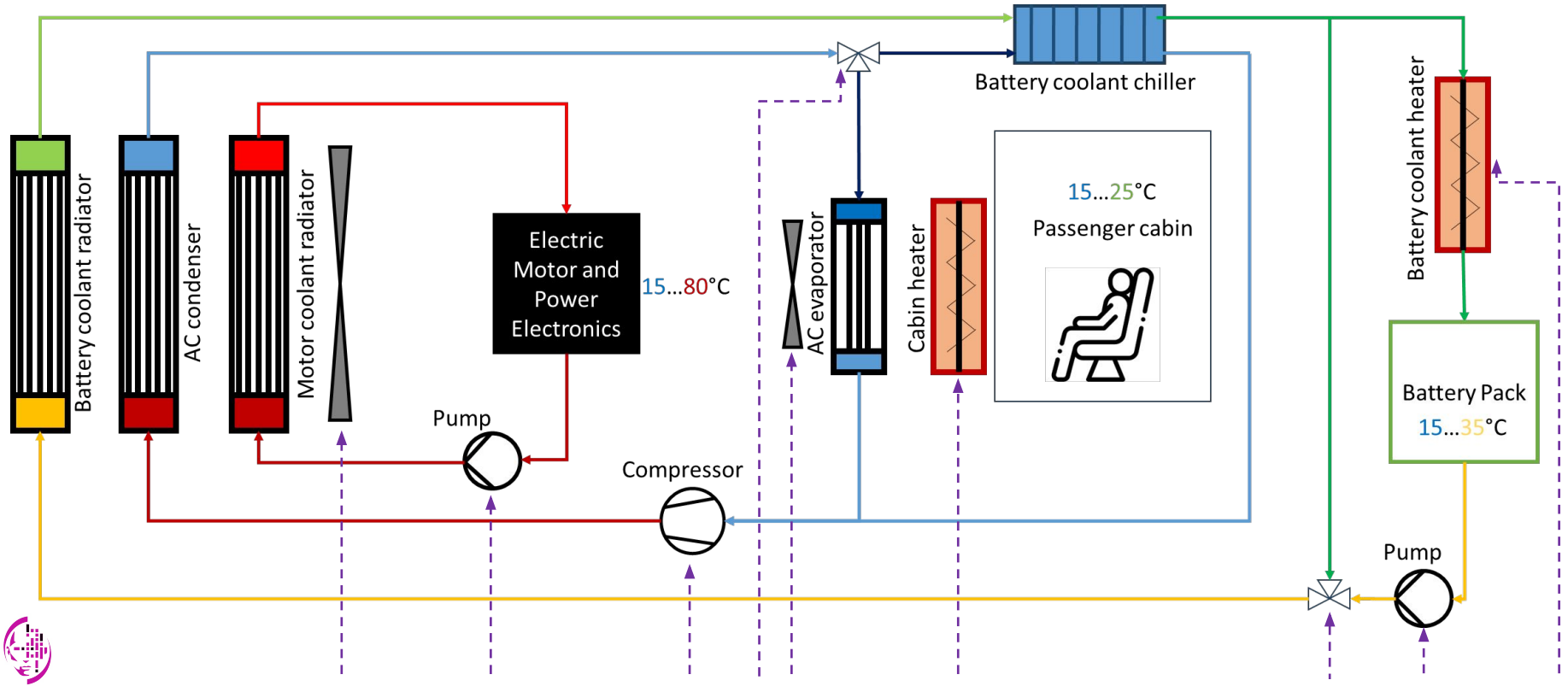
Driving suggestions – EV thermal management



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Components that control the vehicle's thermal management system, with its various thermal demands

Driving suggestions – EV thermal management

- Challenge
  - High number of active components
  - Varying atmospheric conditions
  - The circuits serving the EVs' powertrain components and cabin comfort have very different operating intervals
- Applicability
  - City buses (or any other vehicles that circulate on the same track)

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Driving suggestions – City bus case study

Known information

- Upcoming route sector and road profile
- Atmospheric and traffic conditions
- Load patterns (number of passengers between stops)

Proposed solution

Offer driving suggestions:

- Reduce acceleration on the next street
- Use more regenerative braking on the descent
- Stop cabin heating/cooling after the next stop
- Etc.

Goal

Optimize the thermal management system's energy consumption

Paving the way for autonomous vehicles' thermal management control

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Collaboration inquiry/offer

Open for

- **research collaborations**
- **joint research proposals**
- **knowledge transfer**

on

✔ Extending battery State-of-Health and lifetime prediction models

✔ Developing AI-generated driving suggestions to increase electric vehicles' energy efficiency

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