

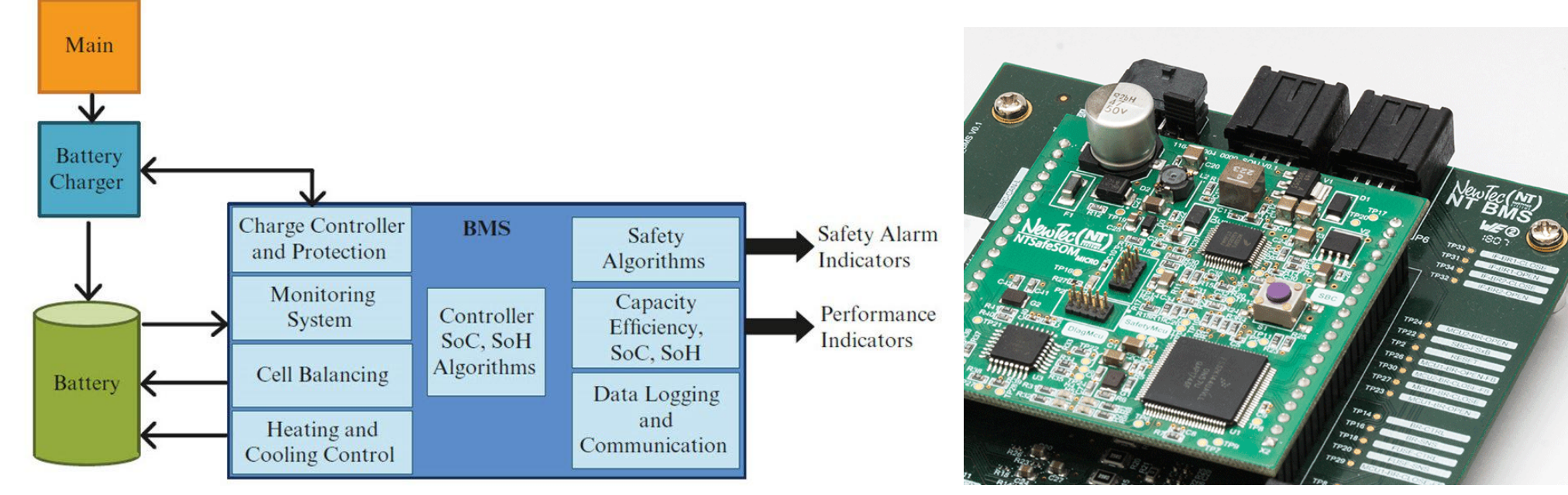
# Implementation of IMM in Battery Management System

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EECOMOBILITY (ORF) &  
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## What IS the BMS?

The Battery Management System (BMS) ensures the safe and reliable operation of a battery pack by monitoring, predicting, and protecting against potential faults or dangerous trends in the system. It accomplishes this by processing information from monitoring sensors and communicating with other components of the vehicle.

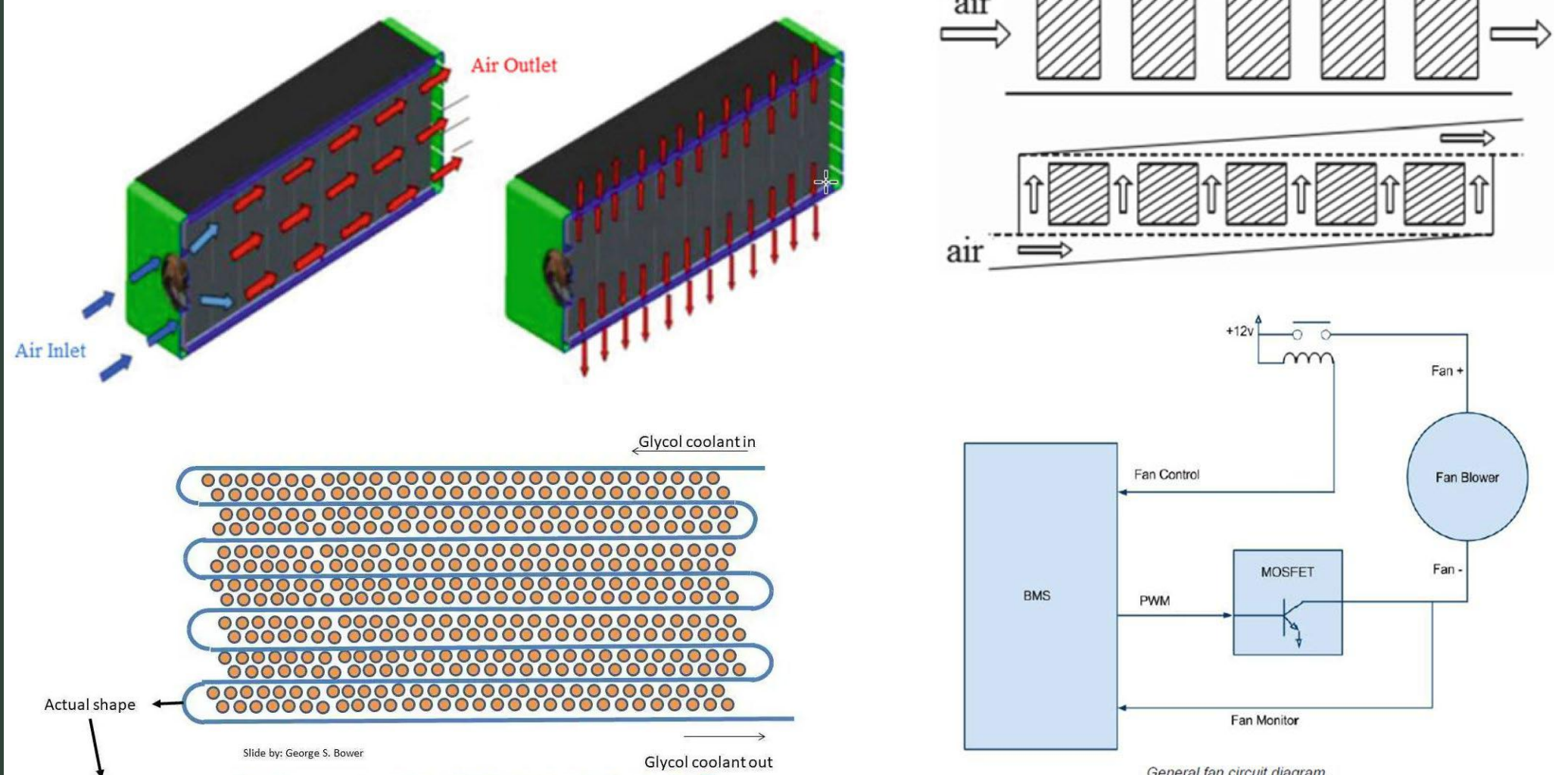


In general, there are different types of BMS: microprocessor-driven, microcontroller-operated, PLC-controlled, and LabVIEW-powered

Efficiency, lifespan, and safety are enhanced by the battery management system: adjusts cutoff voltage and charging current, regulates SoC range, balances cells, and controls temperature for optimized battery performance.

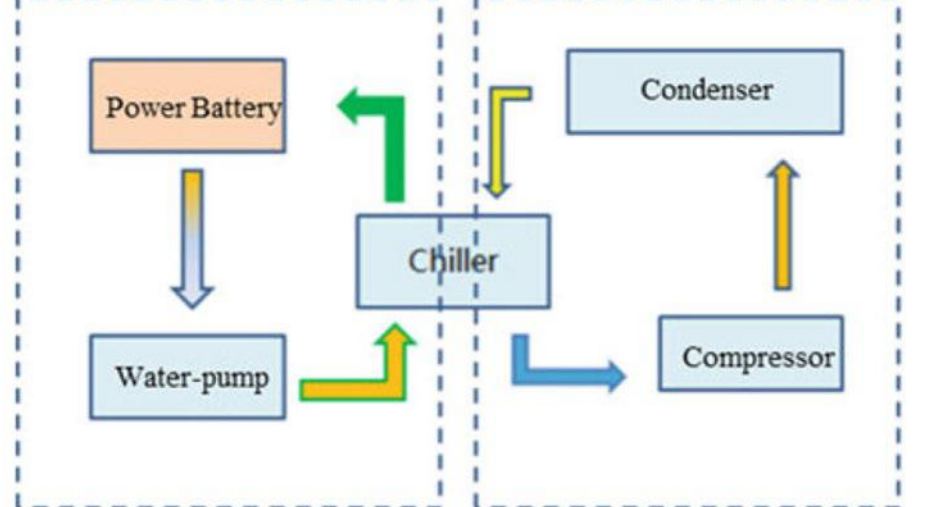
## Thermal control

There are air cooling, liquid cooling and cooling using PCM. Air cooling and liquid cooling are commonly applied.



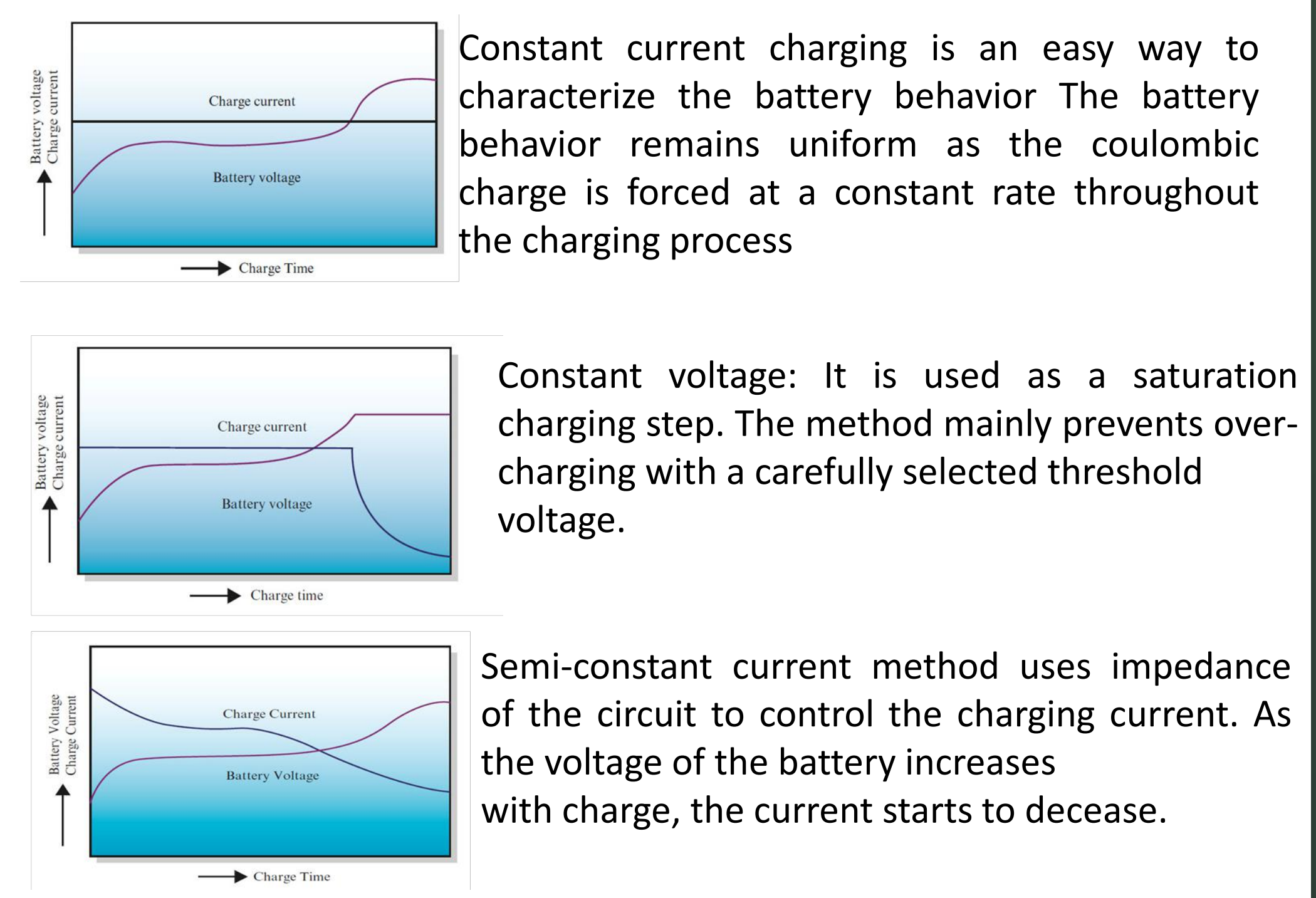
↑ In liquid cooling, battery is cooled by oil, water etc. Liquid cooling efficiency is higher than air cooling due to the larger heat capacity for liquid than air ↓

↑ The BMS controls the fan speed via PWM signal with respect to cell and ambient temperature for warming up or cooling the pack

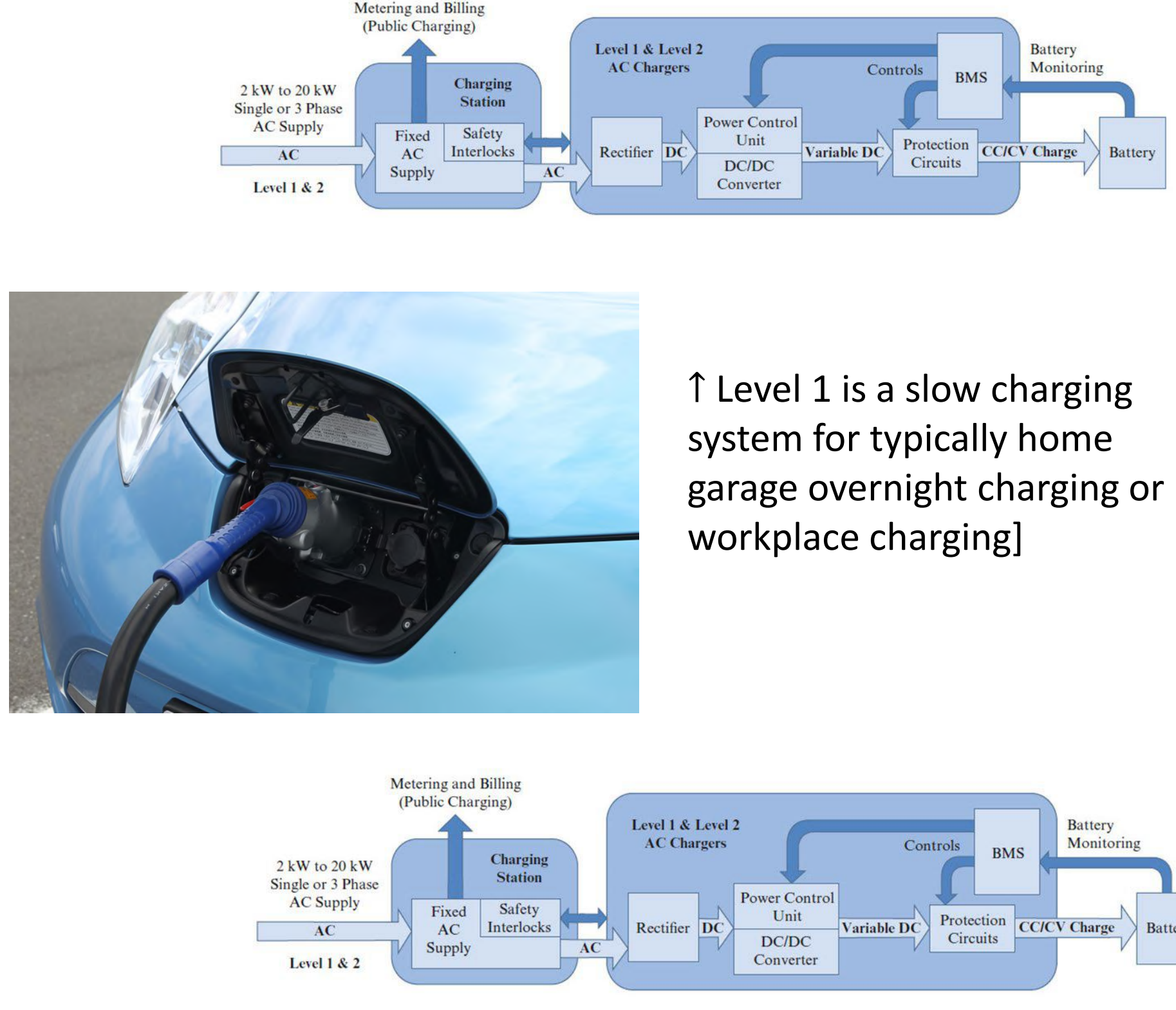


## Charging Modes

Battery charging optimized with BMS: constant current and voltage techniques used for efficient and safe charging.

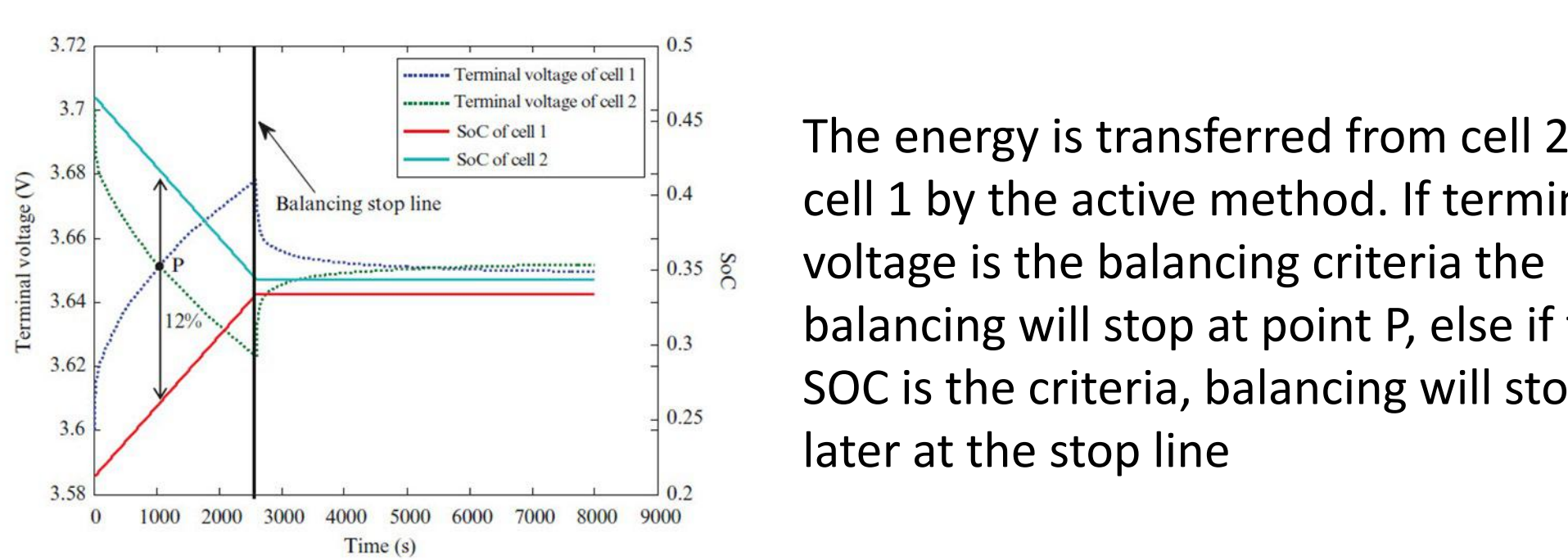
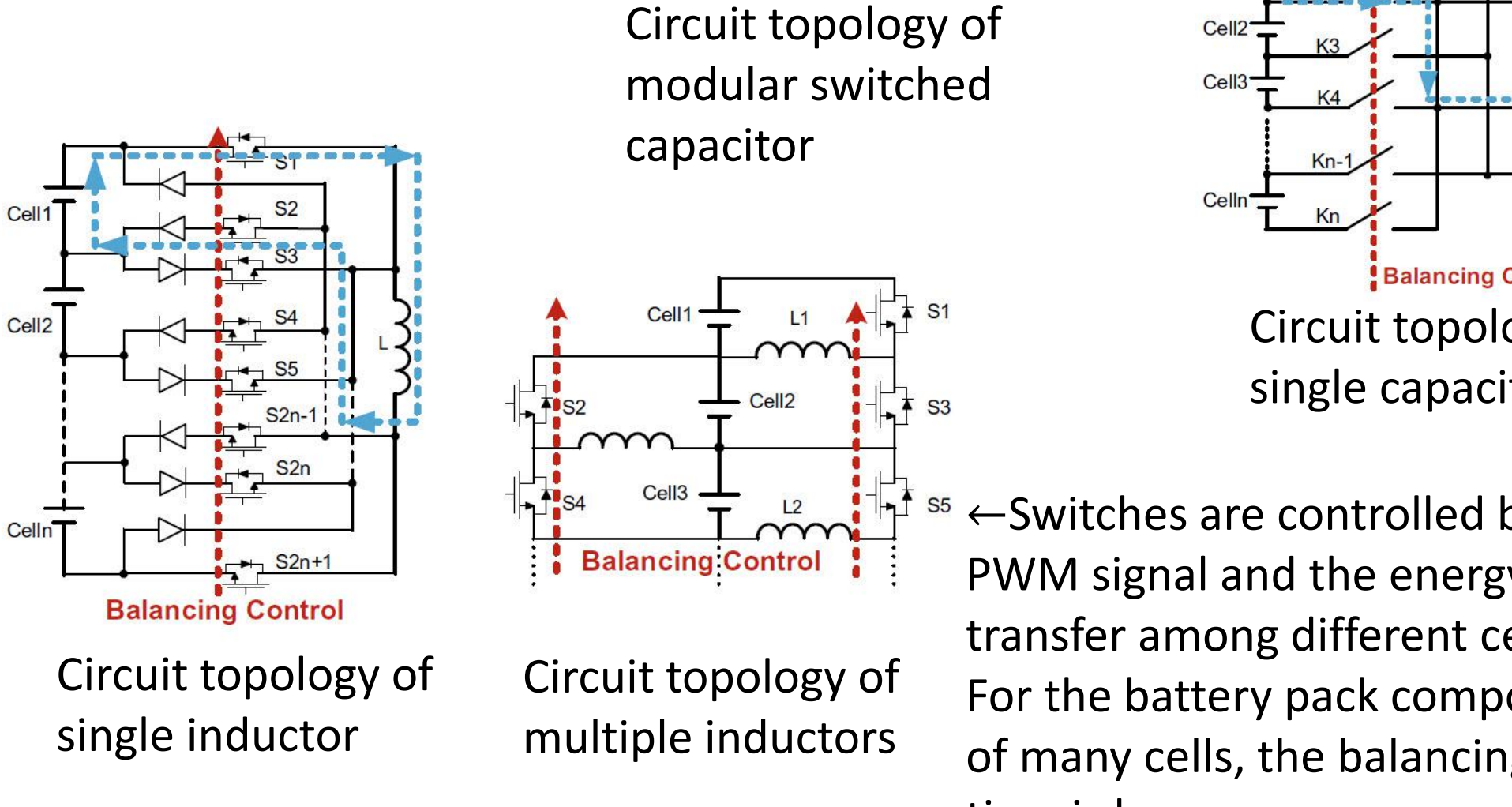
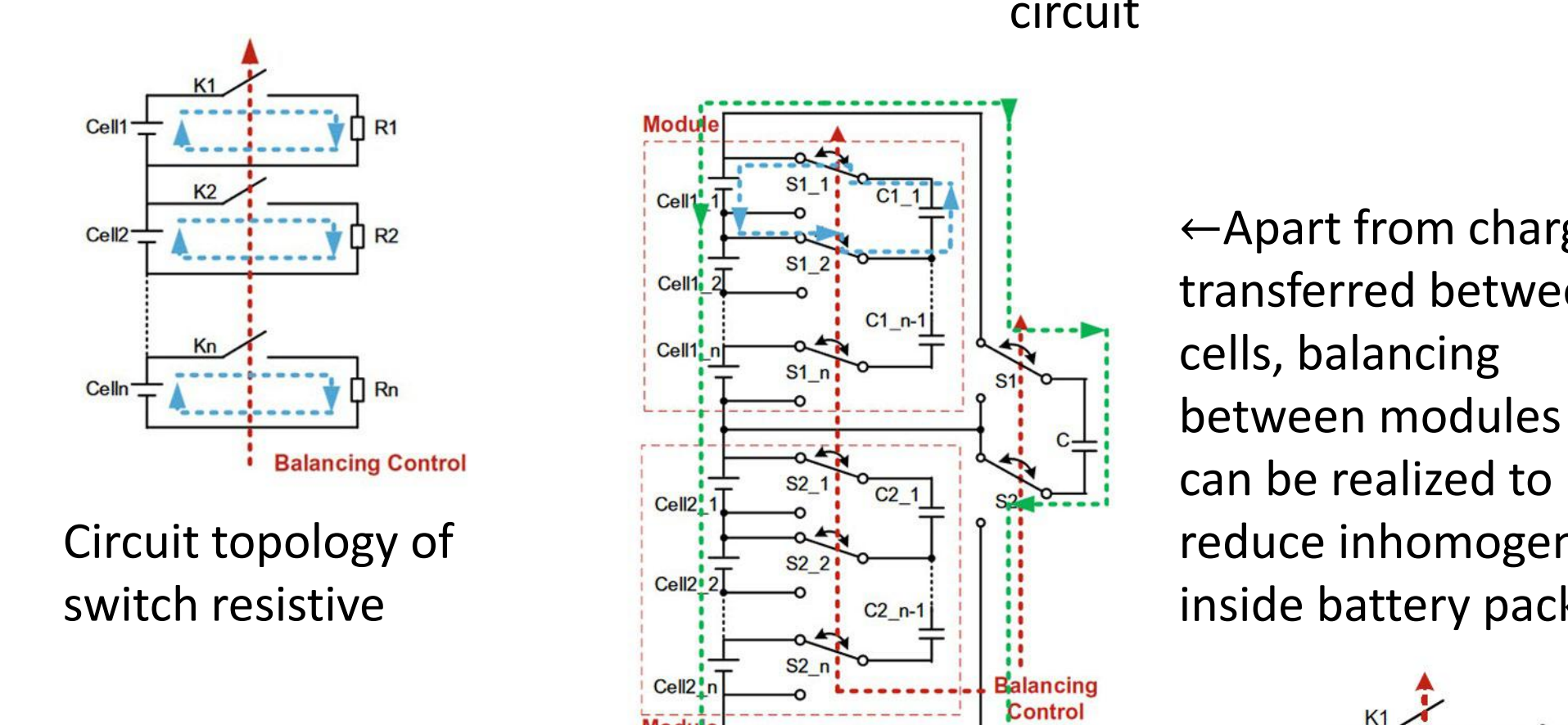
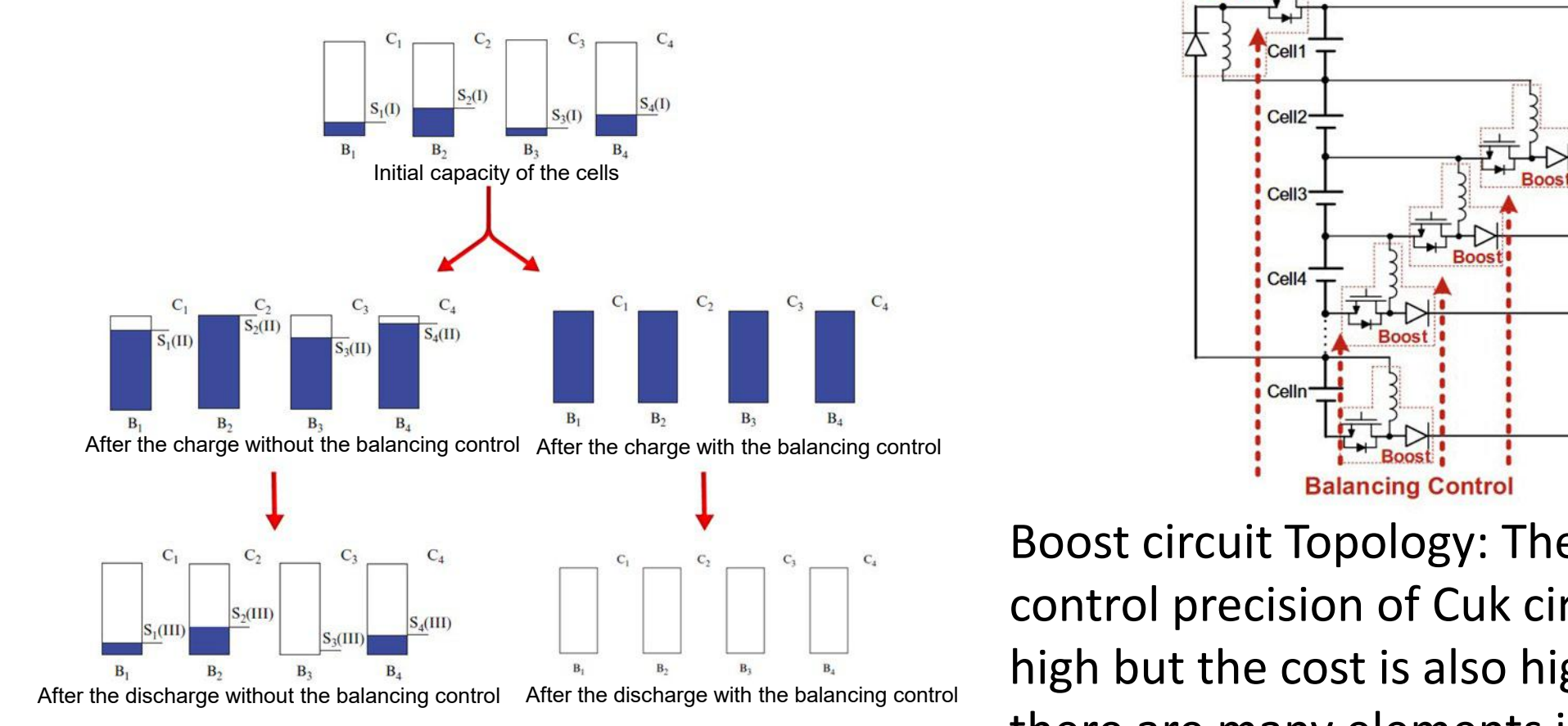


Based on the infrastructure and power capacity, battery chargers are categorized in three levels.



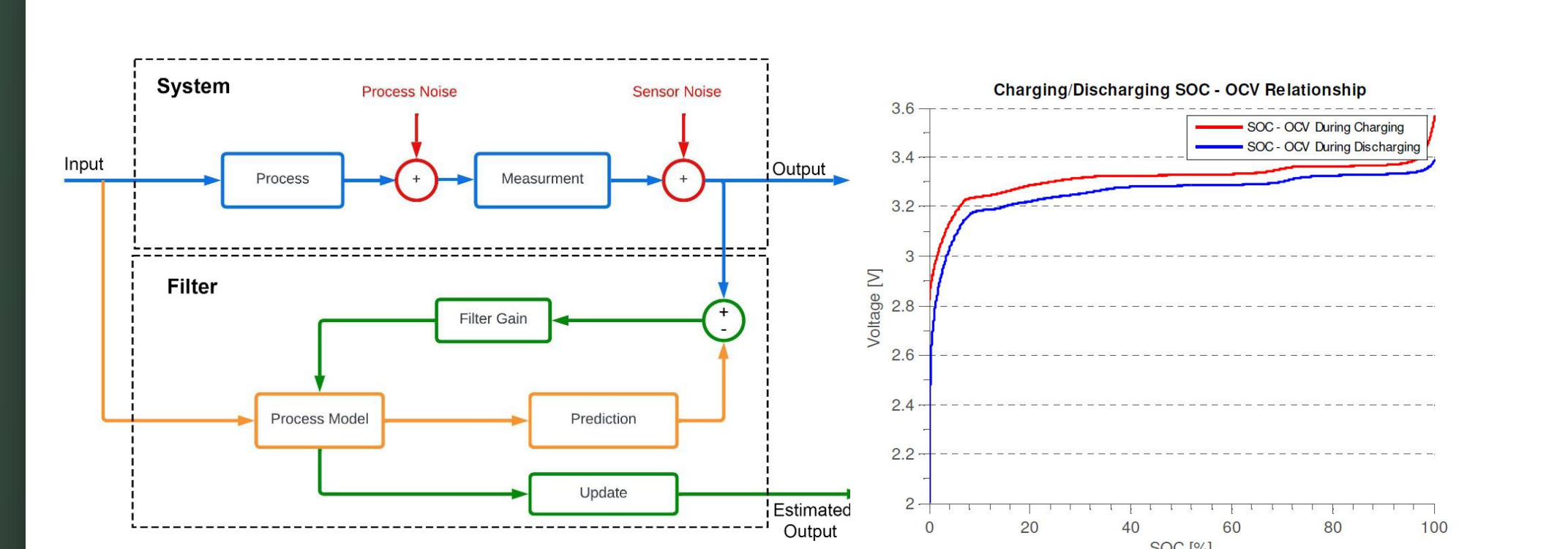
## Cell Balancing

- improves the cycle life of the battery
- achieves the uniform aging of the battery pack so that the SOH of the cells is relatively close
- Cell balancing prevents under-charging of good cells and over-charging of weak cells, which increase the overall age of the pack.
- There are different types of cell balancing topologies which can be categorized as active and passive.

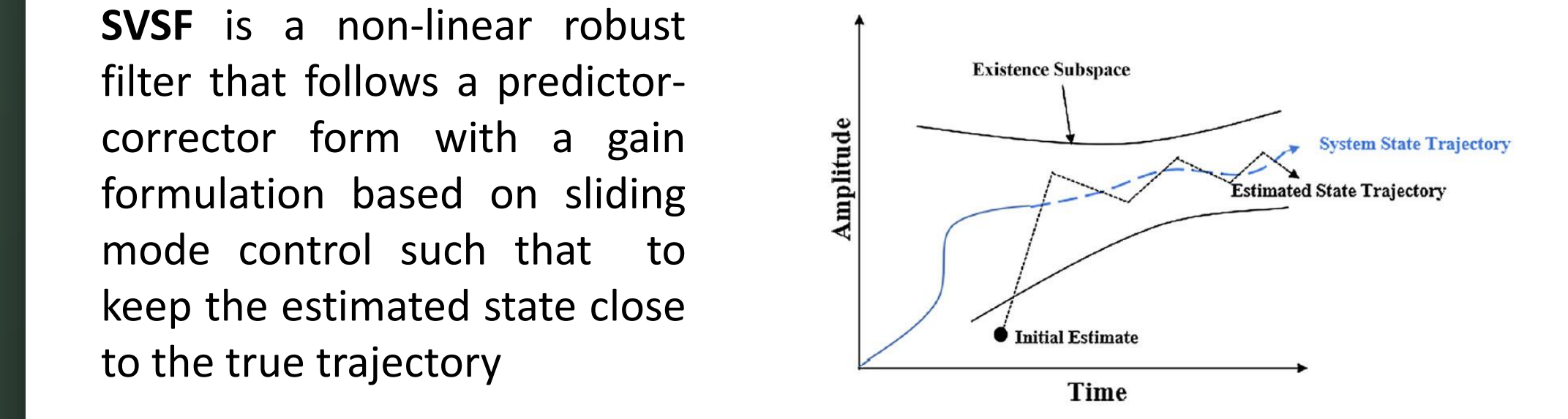


## Battery States Estimation

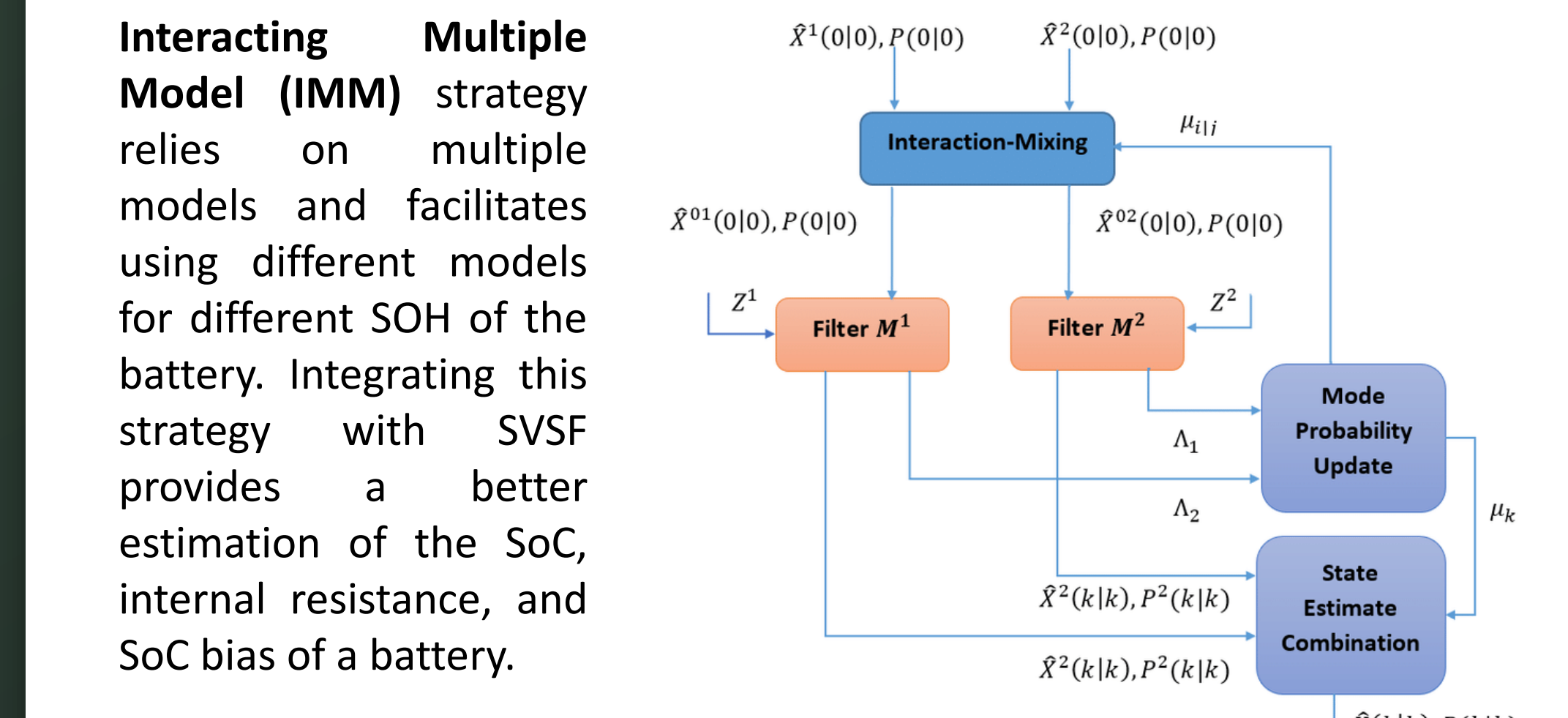
Flat region in SOC curve → battery model → model and process uncertainties → estimator-model combination ✓



- Kalman Filter**
- Prediction phase → The system states are estimated based on the previously available data
  - Correction phase → The prediction phase output is updated with respect to new data (to reduce the estimation error as much as possible)



chattering may occur, but this can be resolved by using a smoothing boundary layer



## References

Available at: [https://github.com/Rezahnd/Poster\\_2022/blob/main/references.md](https://github.com/Rezahnd/Poster_2022/blob/main/references.md)

