«Multi-level models and energy management of innovative charging stations for electrified vehicles»

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- Outline -

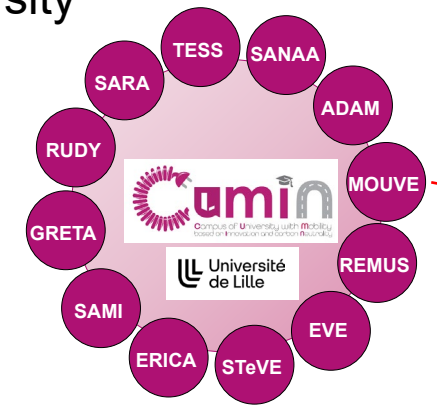
1. Context and objective
2. Multilevel modeling
3. Simulation results
4. Conclusion

« Context and objective »

Multi-level models and MES of innovative charging stations for EV

Context and objective

- University



CUMIN: **C**ampus of **U**niversity with **M**obility based on **I**nnovation and carbon **N**eutral

MObility and **U**se of electric **VE**hicles based on dedicated charging infrastructure

Emulation for testing EVs A. Pam (L2EP-Sherpa)	Charging strategies for EVs A. Ndiyae (L2EP-Ampere)	EV consumption in traction mode for different temperatures D. Ramsey (L2EP-UQTR)	Deployment of EV charging infrastructure in the region HDF J. Frotey (TVES)

- Company

From system level → power devices

ARCHIMEDES

Chips JU

Co-funded by the European Union

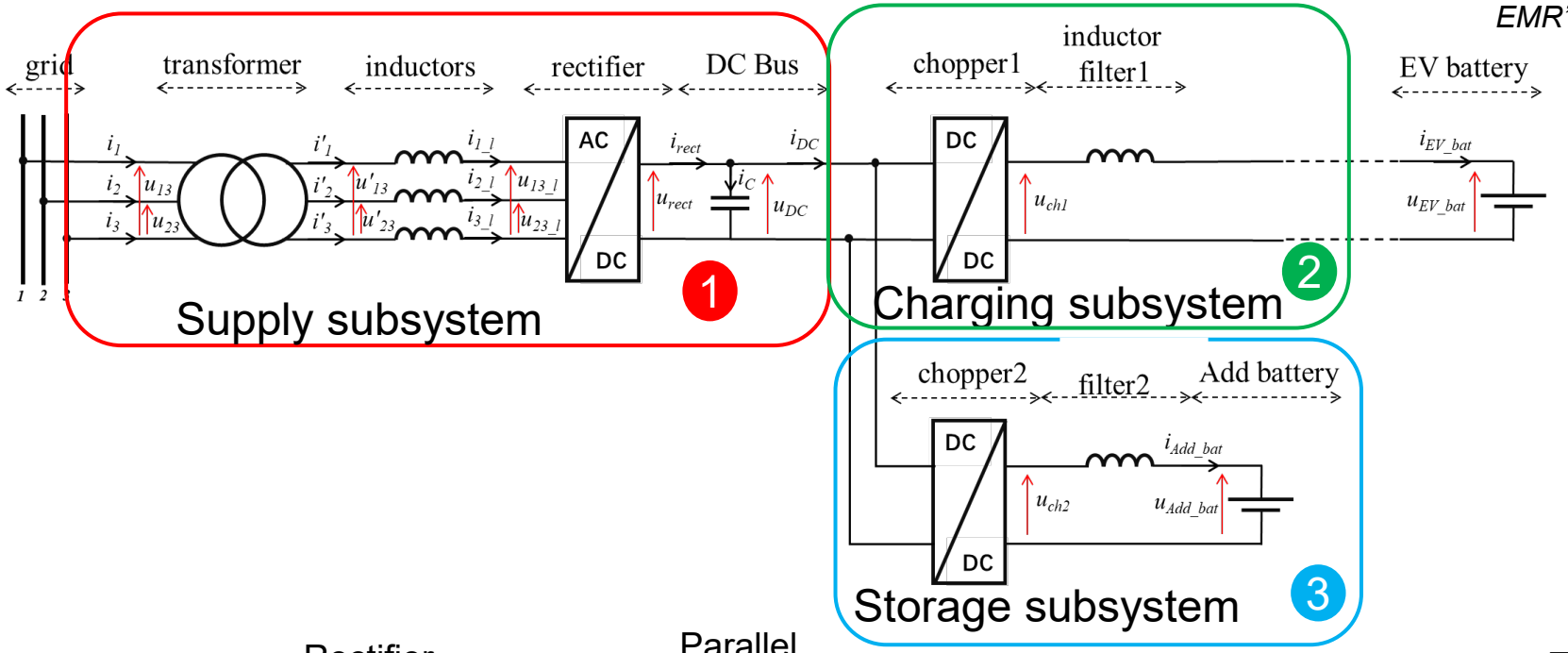
Multi-level models and energy management of innovative charging stations for electrified vehicles
S. Fadili
(L2EP-Sherpa)

« Multilevel modeling »

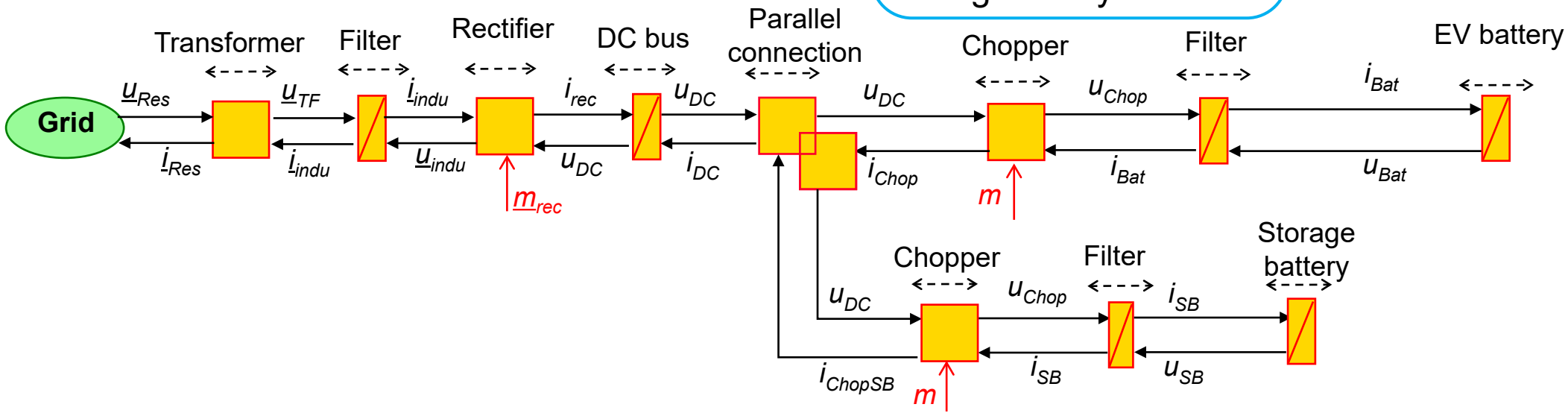
Multi-level models and MES of innovative charging stations for EV

System presentation

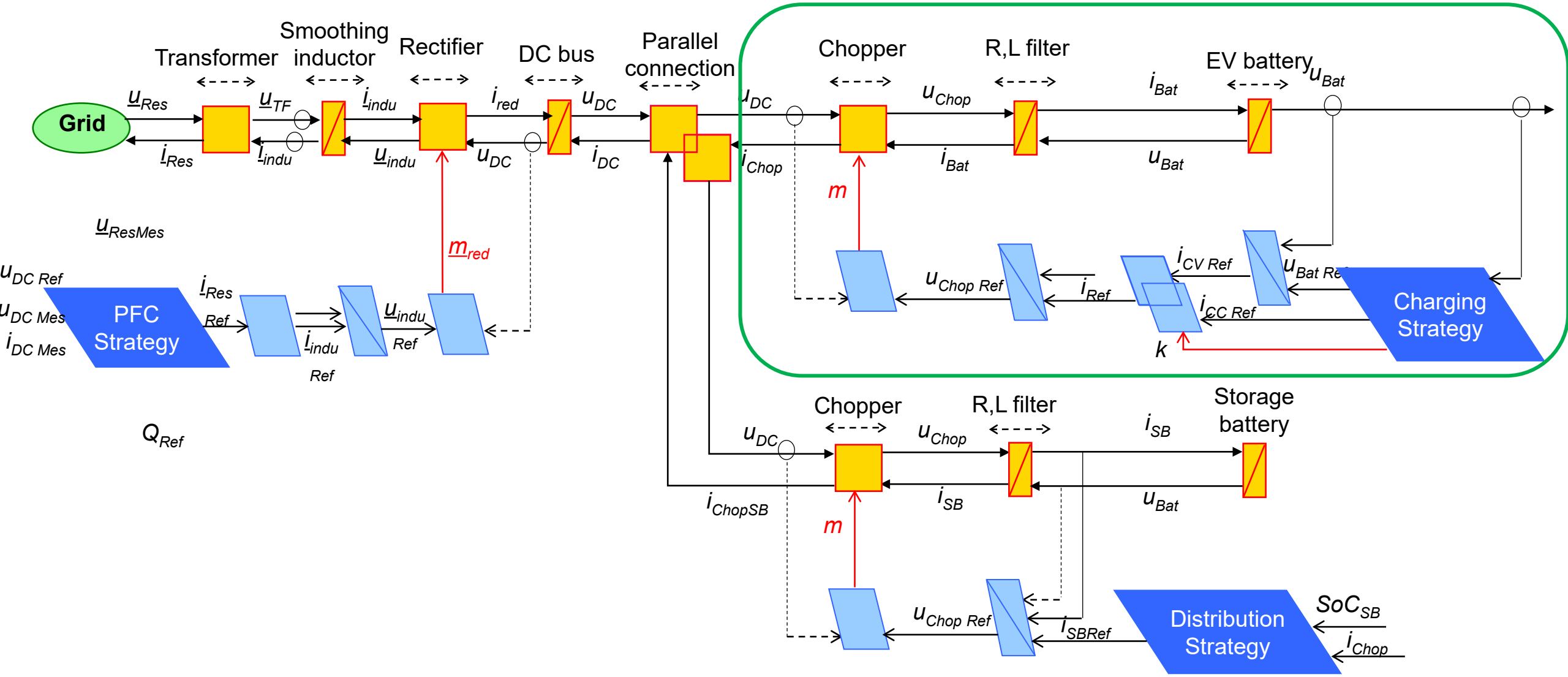
EVbox Troniq 50



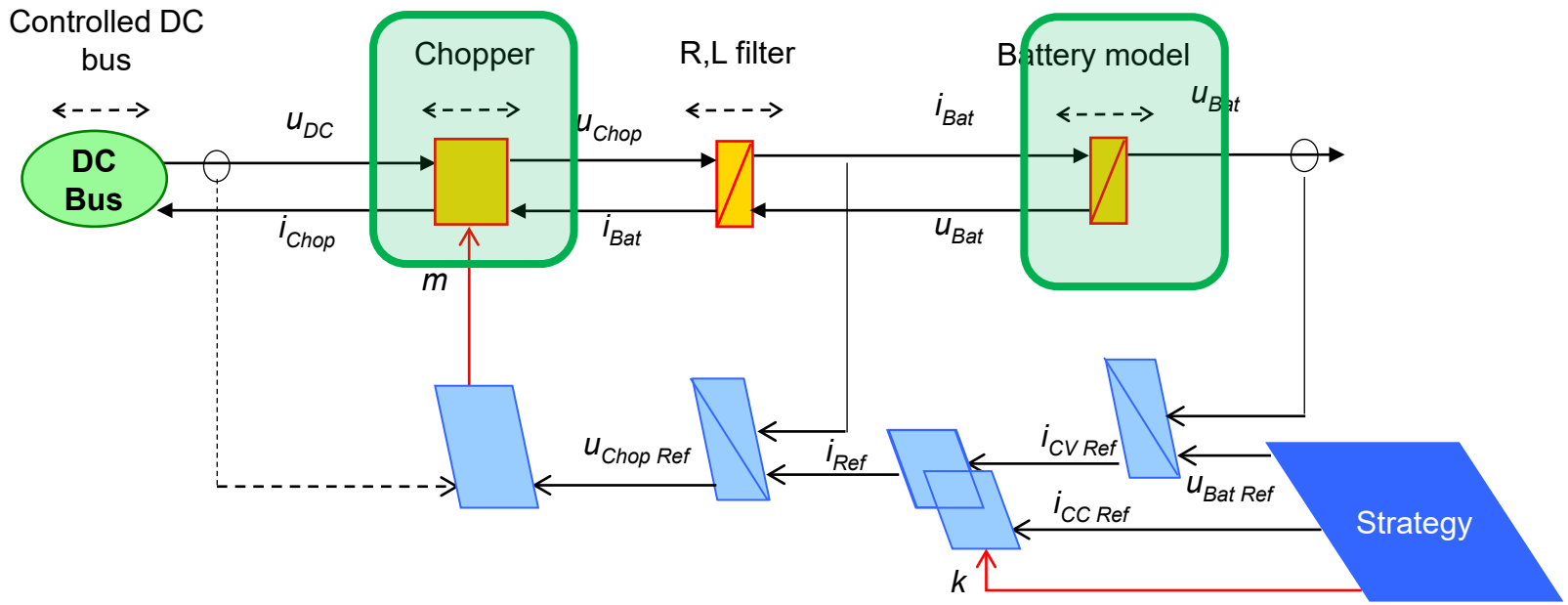
Nissan Leaf



EMR of the system



EMR of the charging subsystem



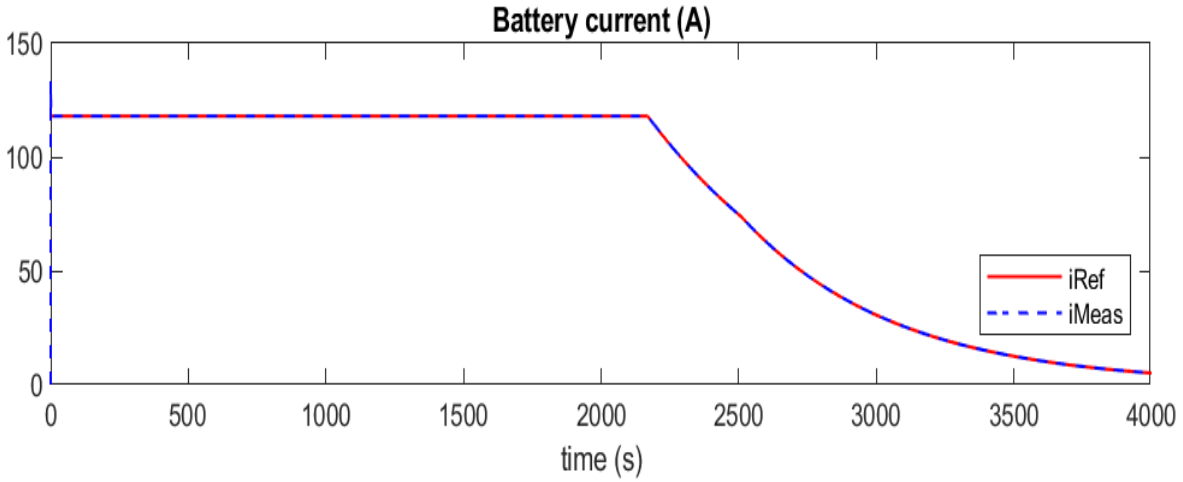
- Chopper multilevel modeling:
  - Average model
  - Instantaneous model
- Battery multilevel modeling:
  - Rint model
  - Electrical model with parallel RC
  - Electrothermal model

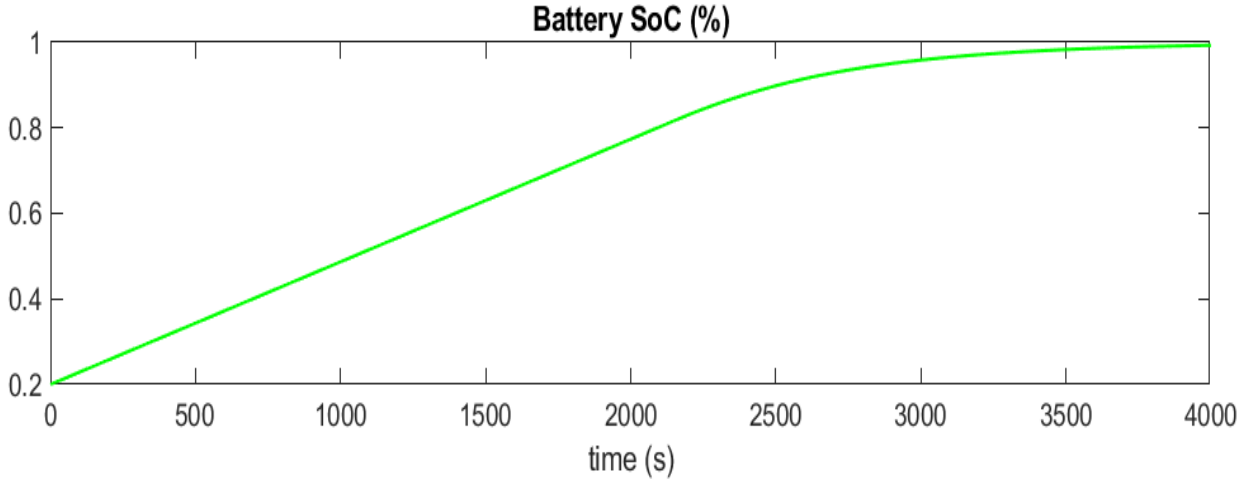
- Multistrategy control:
  - CC-CV charging strategy
  - CP-CV charging strategy
  - Multistage CC-CV charging strategy

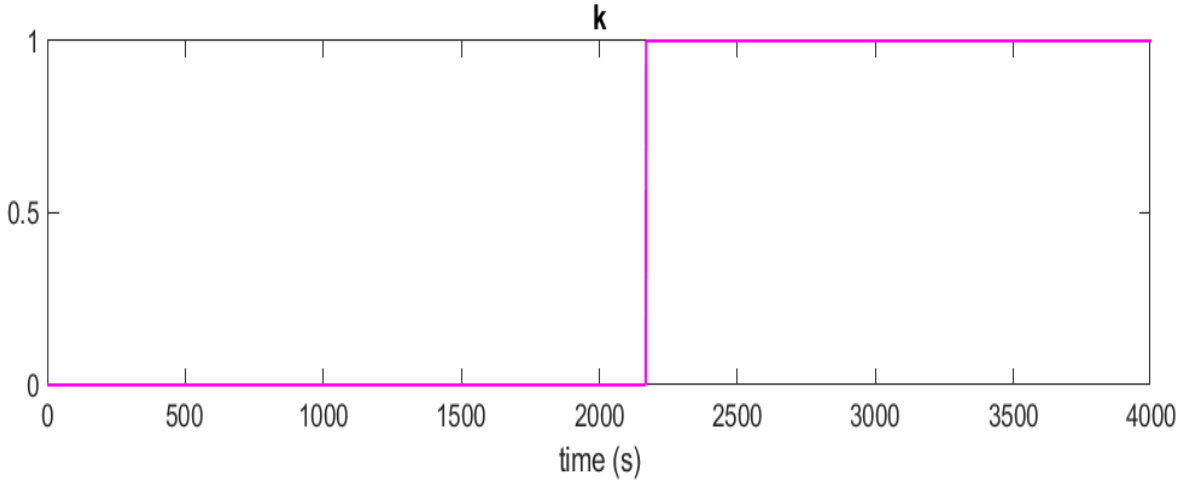
« Simulation results »

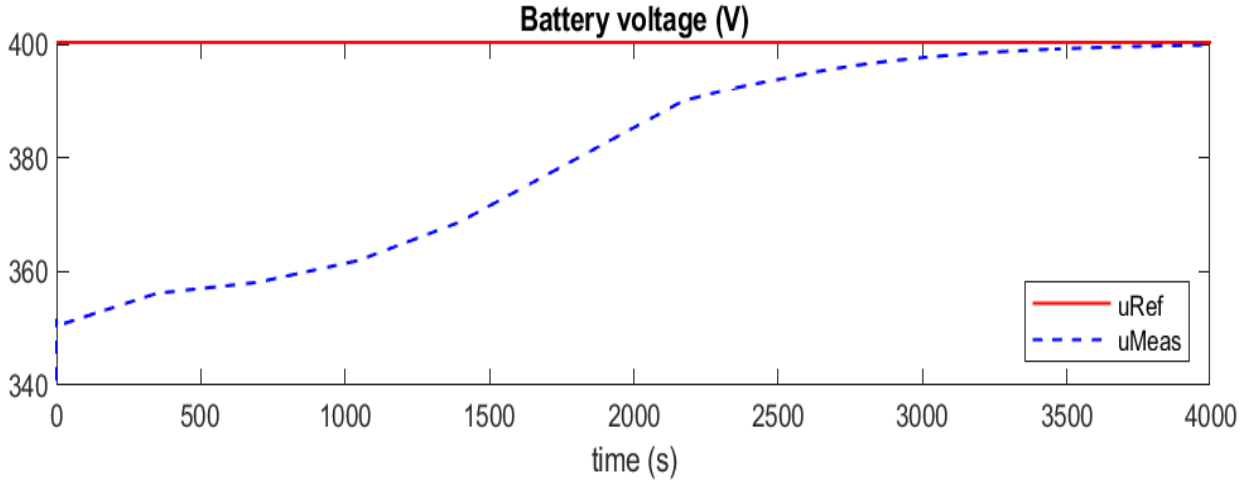
Average model simulation results

- Chopper efficiency: 95%
- CC-CV charging strategy for the EV battery



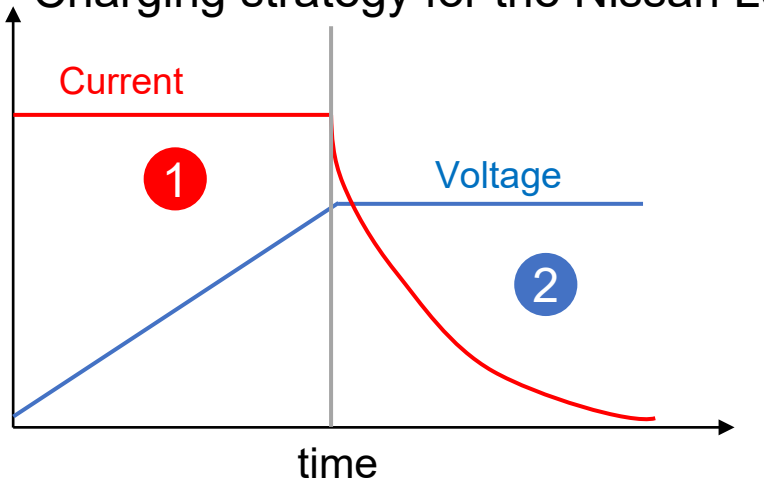






Charging strategy of the Nissan Leaf

Charging strategy for the Nissan Leaf

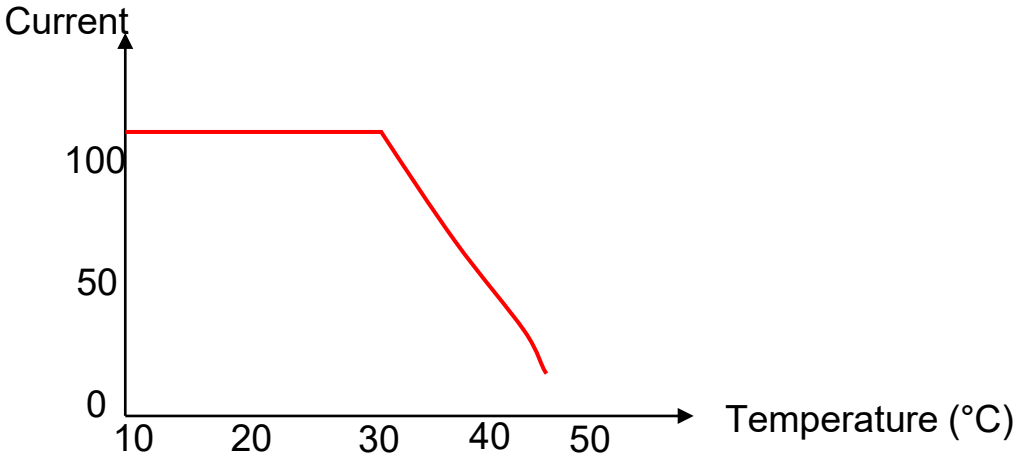


CC-CV strategy

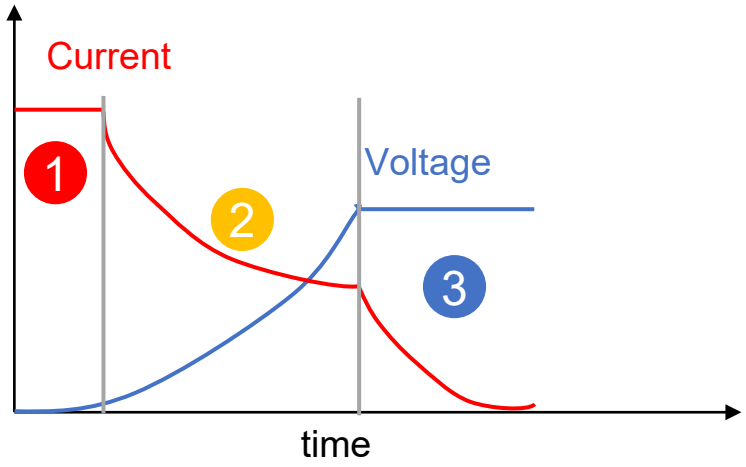
+ Simple to control
+ Widely adopted
+ Balance between speed and battery life

- Heat generation
- Need optimisation

BMS limits the maximal current depending on the temperature



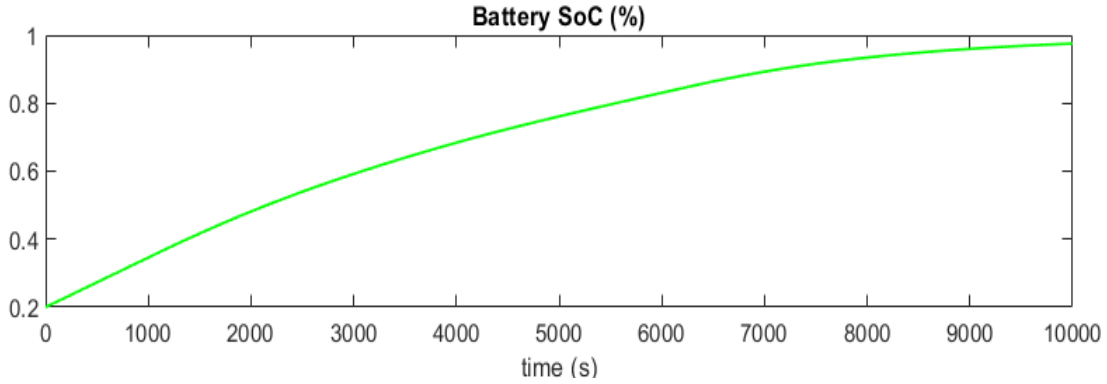
Maximal current according to the temperature

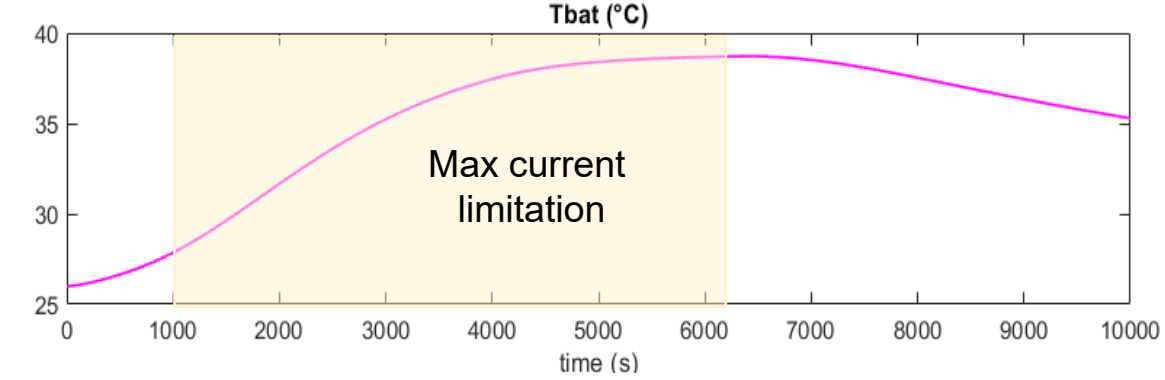


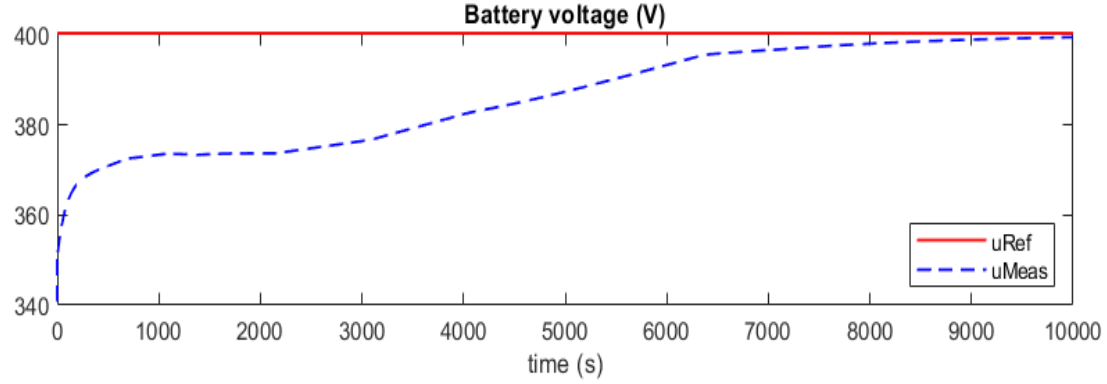
CC-CV with current adaptation strategy

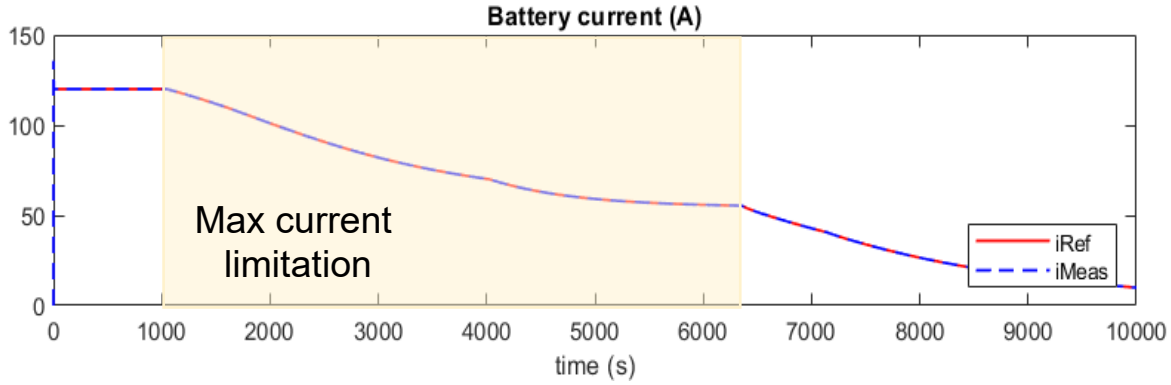
Simulation results

- Fast charge with the electrothermal model initial battery temperature: 25°C









Charging time (20%-100%)	Slow charge	Fast charge
Rint model	7 hours	1 hour 10 mins
Thevenin model	11 hours 10 min	1 hour 50 mins
Electrothermal model	11 hours 10 min	2 hours 50 mins

« Conclusion »

Multilevel modeling of a fast-charging station

- EMR formalism for the global organisation
- MCS is used for the CC-CV strategy
- Different case studies need different levels of details
- EMR can be used for multilevel models
  - Rint battery model
  - Thevenin battery model
  - Electrothermal battery model

Thanks for your attention !

References

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