



EMR'22
HES-SO Sion
June 2022



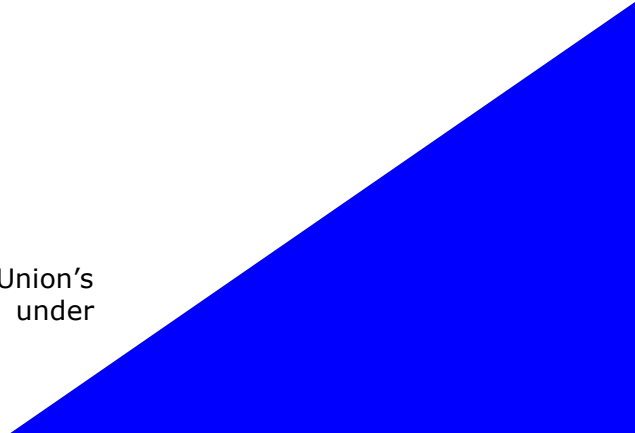
EMR'22 Summer School
"Energetic Macroscopic Representation"

E-drive HIL testing using EMR for a BEV

Dr. Mircea RUBA, eng.Tudor MOLDOVAN, eng.Raul NEMES
 Technical University of Cluj Napoca, Romania



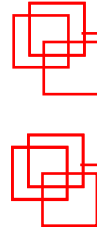
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824256.



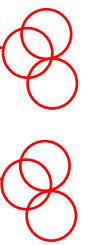
- 1** EMR Modelling
- 2** HIL test setup
- 3** Results
- 4** Conclusions



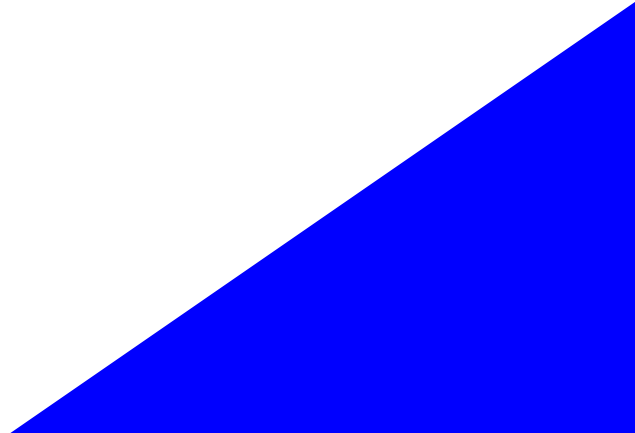
EMR'22
HES-SO Sion
June 2022



EMR'22 Summer School
“Energetic Macroscopic Representation”



EMR Modelling

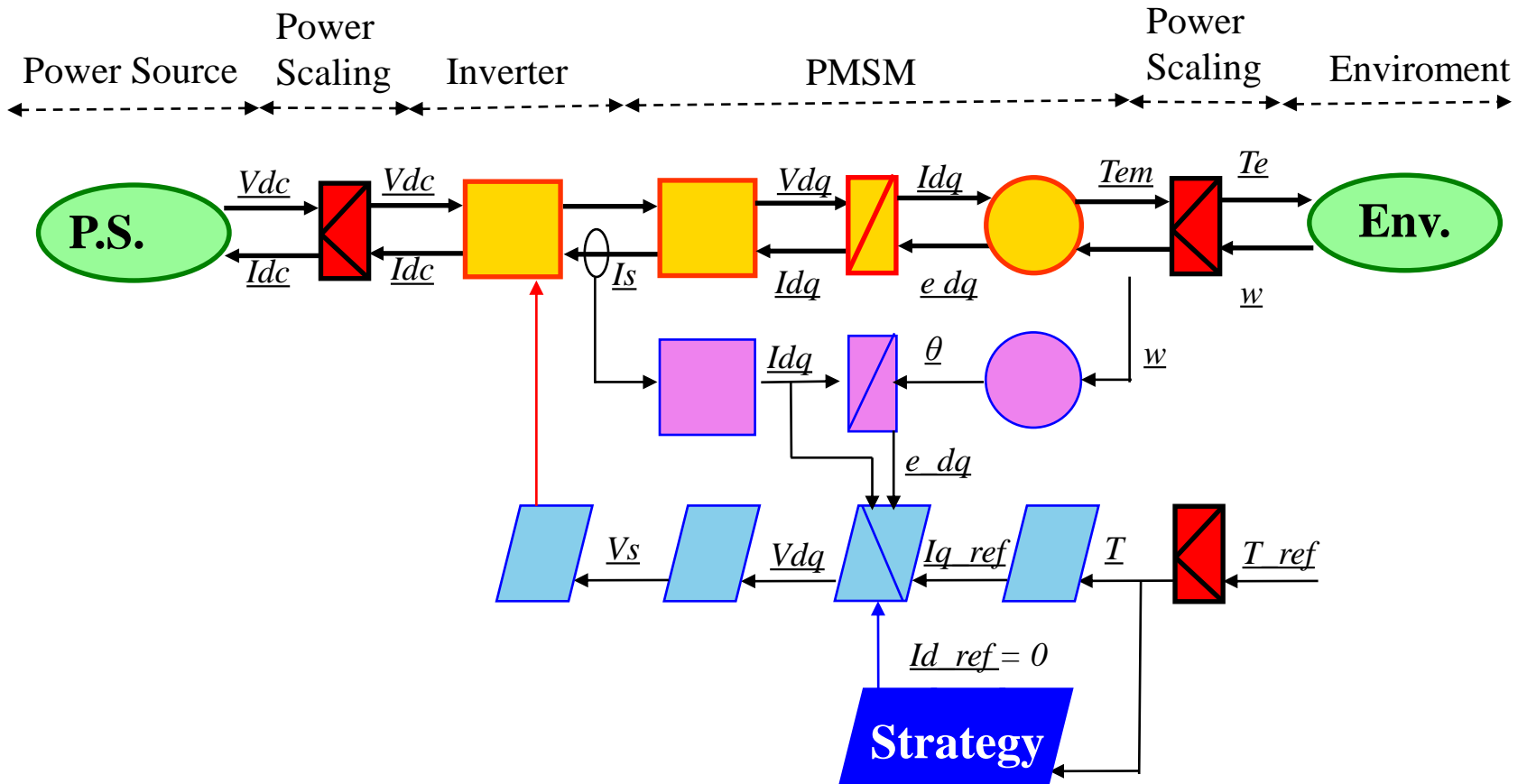


E-drive HIL testing using EMR for a BEV

- EMR Model -

EMR'22, Sion, June 2022

4

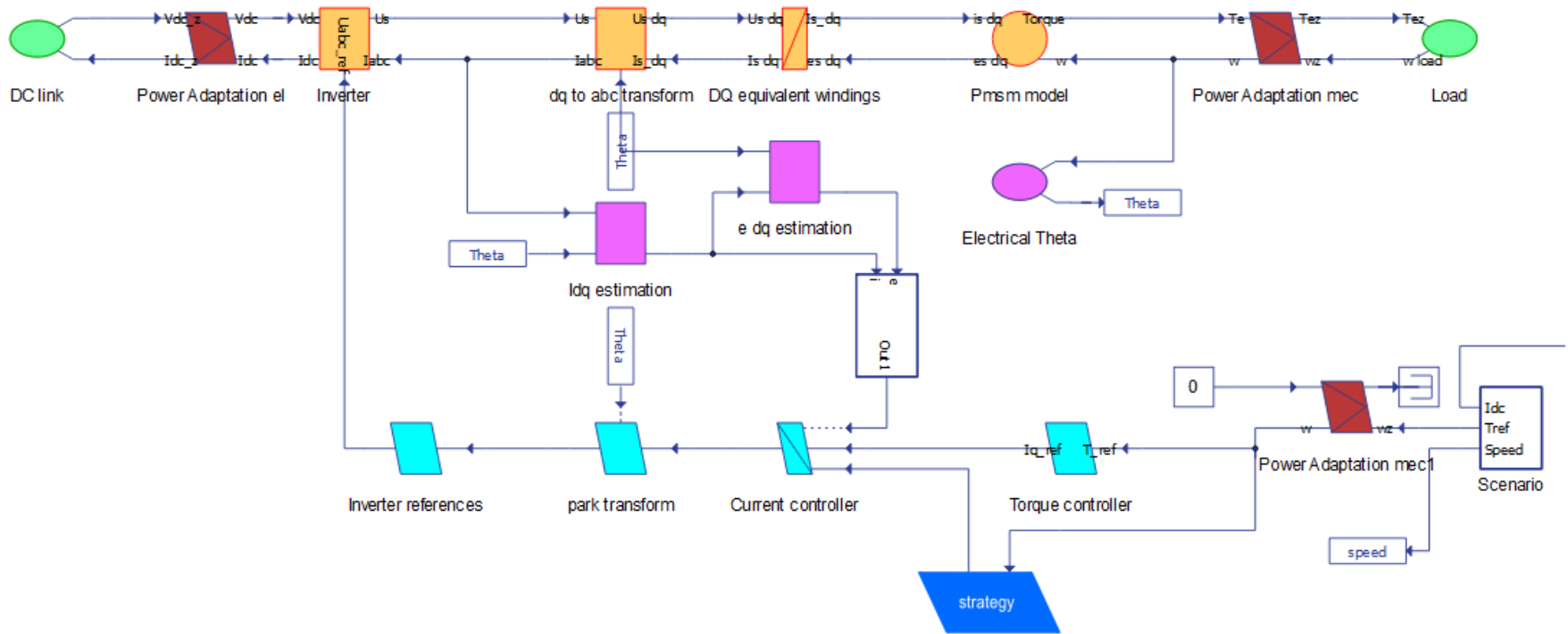


E-drive HIL testing using EMR for a BEV

- EMR Model in Typhoon HiL -

EMR'22, Sion, June 2022

5



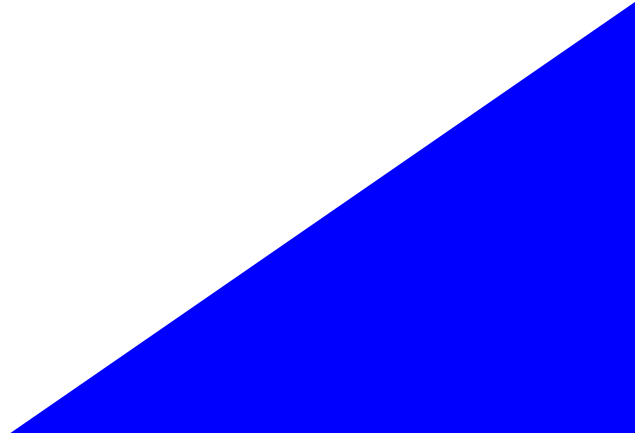


EMR'22
HES-SO Sion
June 2022



EMR'22 Summer School
"Energetic Macroscopic Representation"

HiL test setup

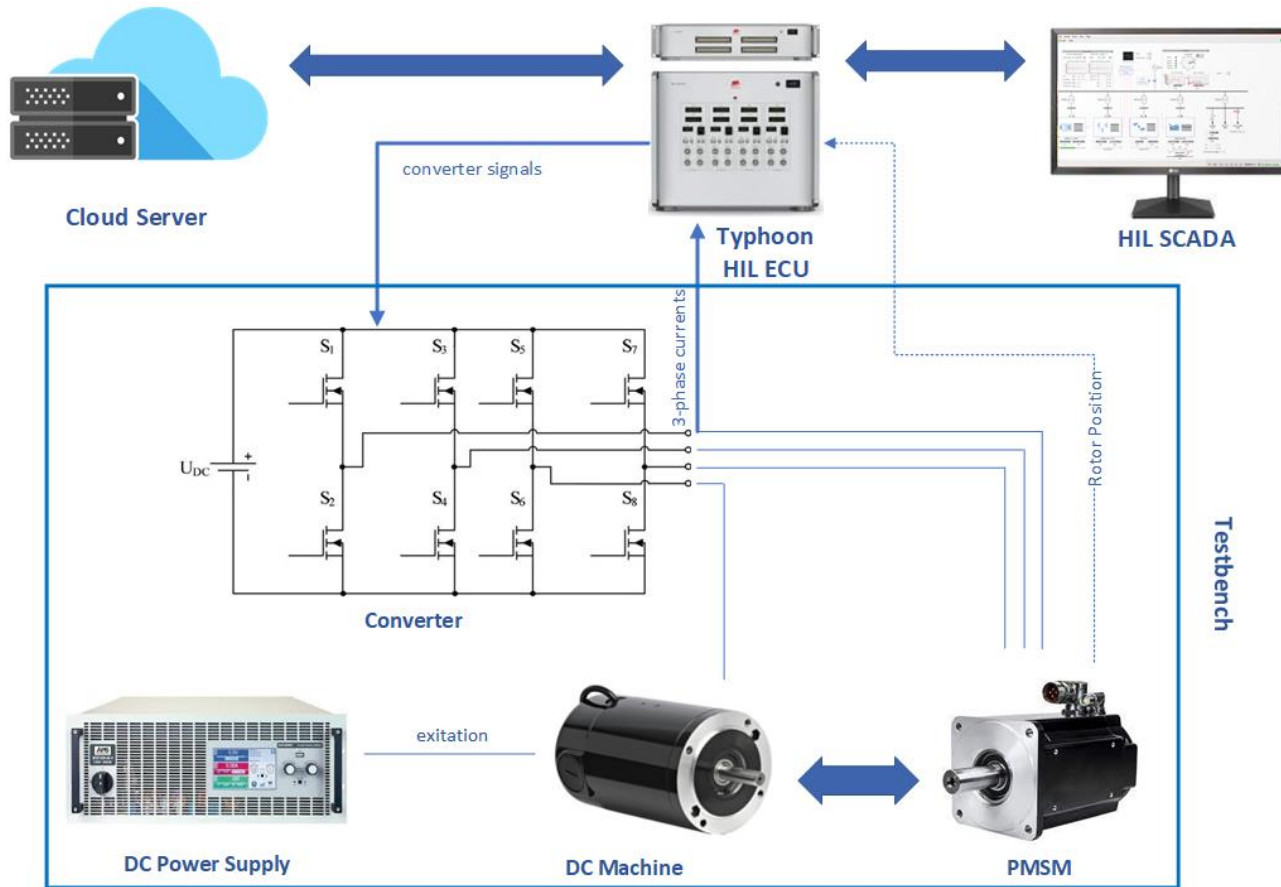


E-drive HIL testing using EMR for a BEV

- HiL setup – Functional schematic -

EMR'22, Sion, June 2022

7

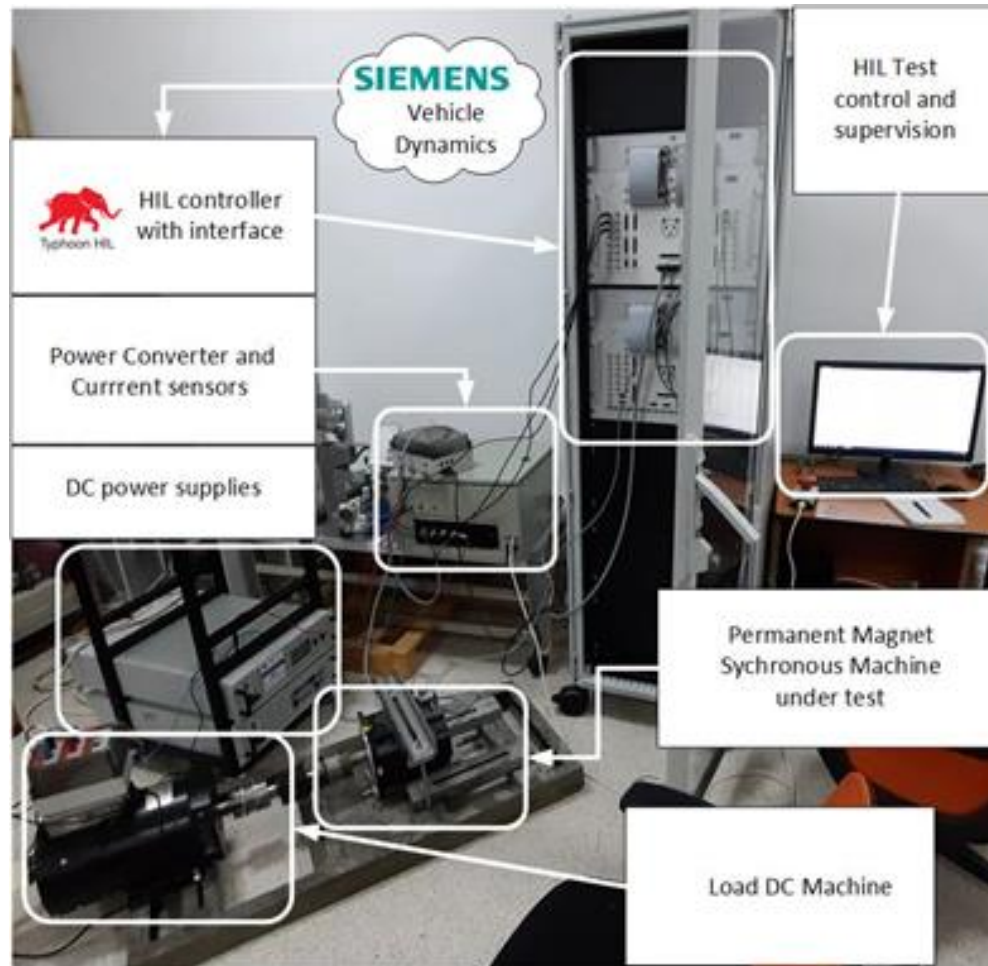


E-drive HIL testing using EMR for a BEV

- HiL testbench setup -

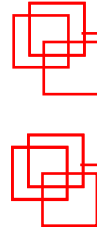
EMR'22, Sion, June 2022

8





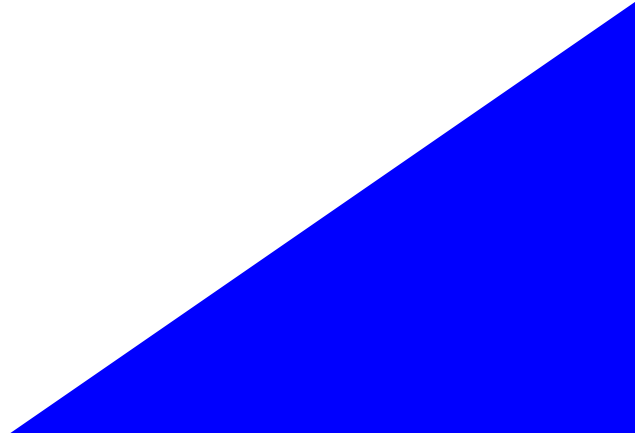
EMR'22
HES-SO Sion
June 2022



EMR'22 Summer School
“Energetic Macroscopic Representation”



Results

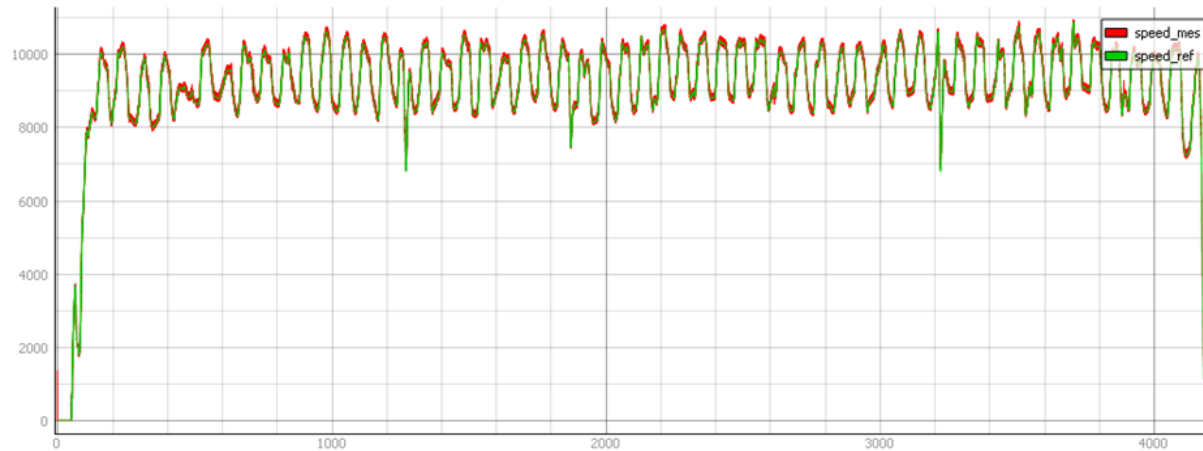


E-drive HIL testing using EMR for a BEV

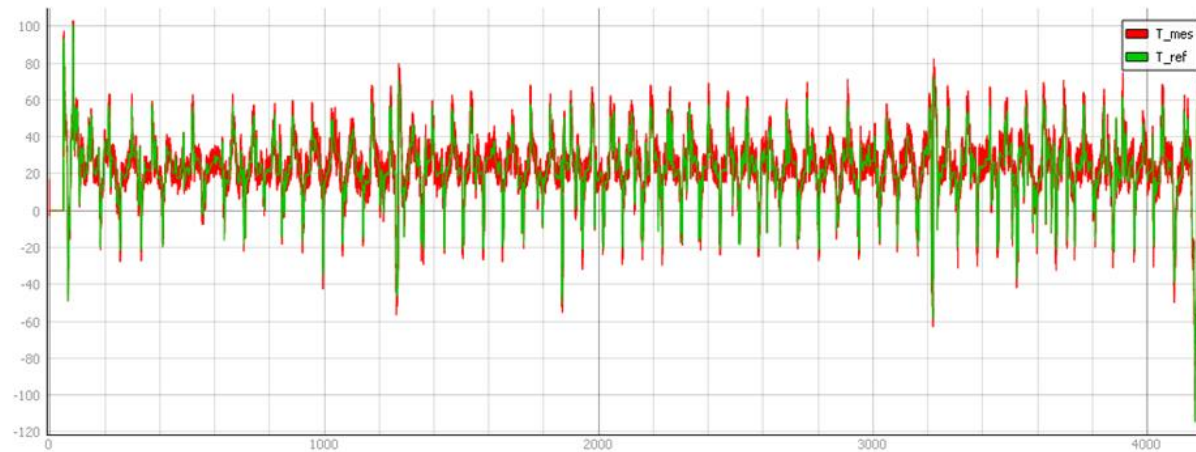
- Highway cycle results -

EMR'22, Sion, June 2022

10



Speed [rpm]



Torque [Nm]

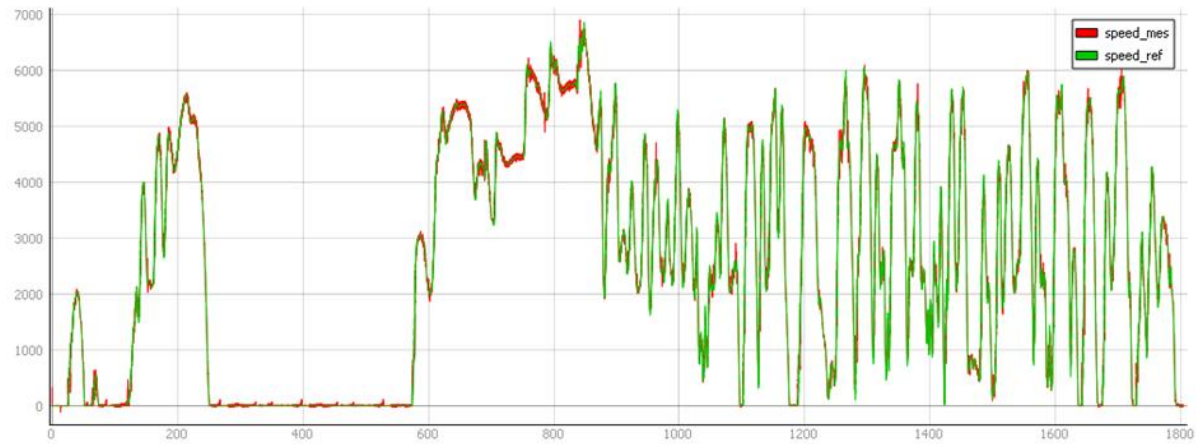
Time [s]

E-drive HIL testing using EMR for a BEV

- City cycle results -

EMR'22, Sion, June 2022

11



Speed [rpm]

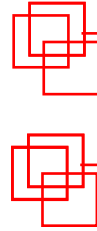


Torque [Nm]

Time [s]



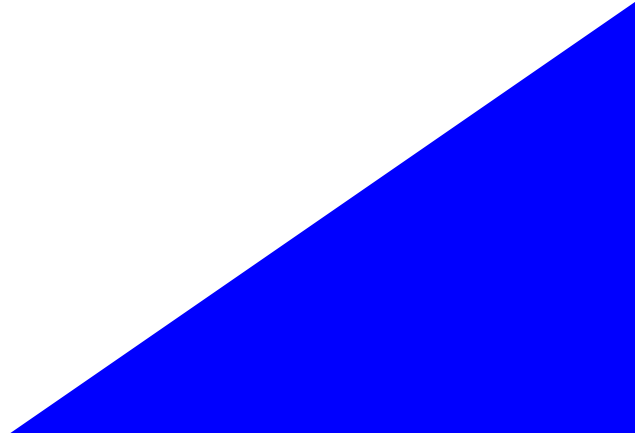
EMR'22
HES-SO Sion
June 2022



EMR'22 Summer School
“Energetic Macroscopic Representation”



Conclusions

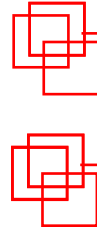


- Conclusions -

- EMR formalism can ease the development process of the control algorithm
- Using EMR eases the transition from MiL to HiL and to cloud counterparts
- Typhoon HIL EMR library is easy to implement



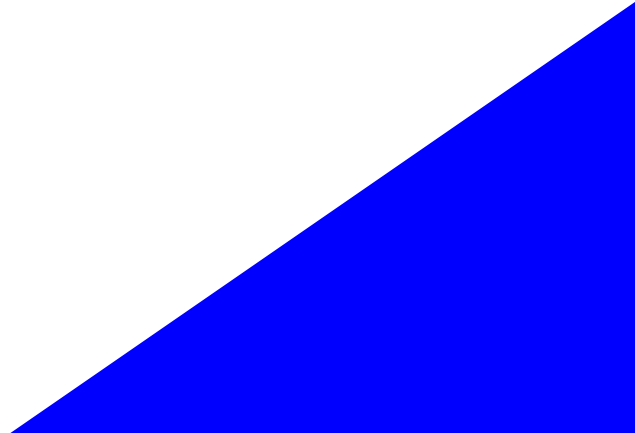
EMR'22
HES-SO Sion
June 2022



EMR'22 Summer School
"Energetic Macroscopic Representation"



« BIOGRAPHIES AND REFERENCES »



Dr. Mircea RUBA

Technical University of Cluj Napoca, Romania

PhD in Electrical Engineering at UTCN (2010)

Research topics: HiL simulation/testing, storage systems, real-time, EV

Email: Mircea.Ruba@emd.utcluj.ro

eng. Raul NEMEȘ

Technical University of Cluj Napoca, Romania

PhD student in Electrical Engineering at UTCN (since 2018)

Research topics: HiL simulation/testing, storage systems, real-time, EV

Email: Raul.Nemes@emd.utcluj.ro

eng. Tudor MOLDOVAN

PhD student in Electrical Engineering at UTCN (since 2020)

Research topics: HiL simulation/testing, storage systems, real-time, EV

Email: Tudor.Moldovan@mae.utcluj.ro

A. Bouscayrol, J. P. Hautier, B. Lemaire-Semail, "Graphic Formalisms for the Control of Multi-Physical Energetic Systems", Systemic Design Methodologies for Electrical Energy, tome 1, Analysis, Synthesis and Management, Chapter 3, ISTE Willey editions, October 2012, ISBN: 9781848213883.

M. Ruba, Nagy H., H. Hedesiu, C. Martis, "FPGA based processor in the loop analysis of variable reluctance machine with speed control", AQTR 2016, 19-21 May, Cluj-Napoca, Romania

A. Bouscayrol, "Hardware-In-the-Loop simulation", Industrial Electronics Handbook, second edition, tome "Control and mechatronics", Chapter 33, CRC Press, Taylor & Francis group, Chicago, March 2011, pp. 33-1/33-15, ISBN 978-1-4398-0287-8

A. Bouscayrol, X. Guillaud, P. Delarue, B. Lemaire-Semail, "Energetic Macroscopic Representation and inversion-based control illustrated on a wind energy conversion systems using Hardware-in-the-loop simulation", IEEE transactions on Industrial Electronics, vol. 56, no. 12, December 2009, pp. 4826-4835