EMR'23, Lille (France)

http://emrwebsite.org

EMR-based simulation of an electric subway

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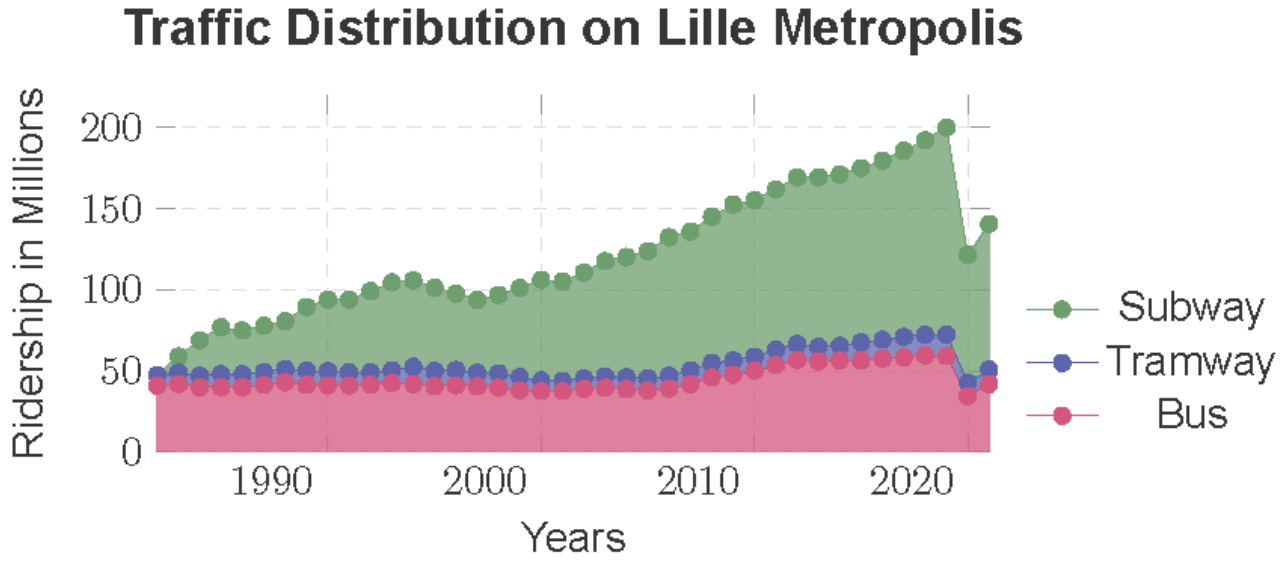
Introduction



source: Métropole Européenne de Lille – Réseau ilévia

NMR Alstom

Crescent subway utilization

Substitution of the vehicle of line 1 of Lille subway system

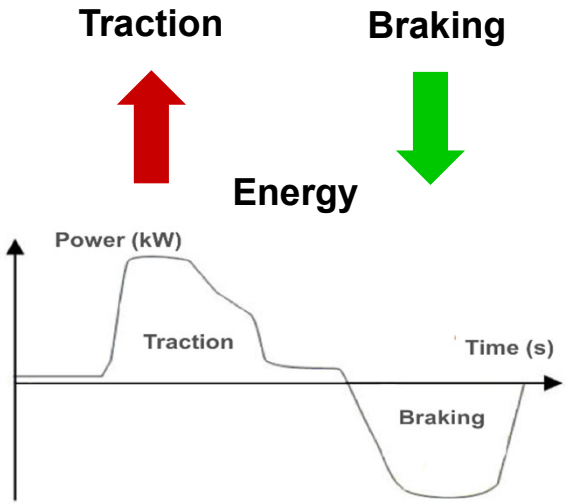
- Vehicle Alstom NMR (Nouveau Matériel Roulant)

Actual vehicle

New vehicle

Traction subsystem

- subway systems are electrified
- regenerative braking capability
- part of braking energy to next subway
- **part of braking energy wasted**



Simulation tool outputs:

- Flexible simulation tools for analysis of energy flow
- Development of innovative solutions and management
- Pre-validation on experimental platform

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Vehicle Modeling

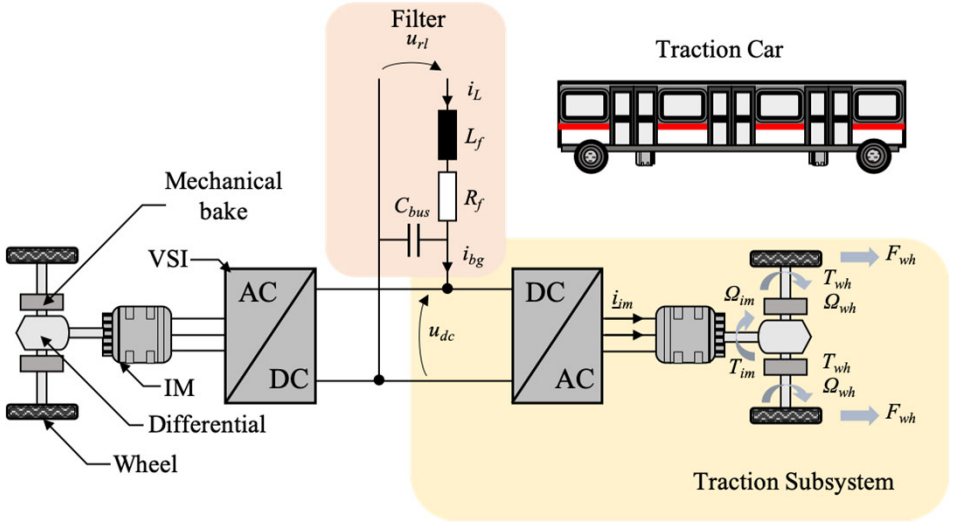
NMR Configuration

Traction car: total of 3

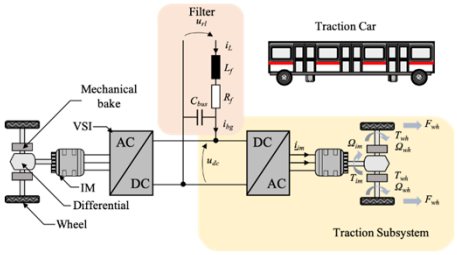
- 2 Bogies (Traction + braking)
- 2 induction machines

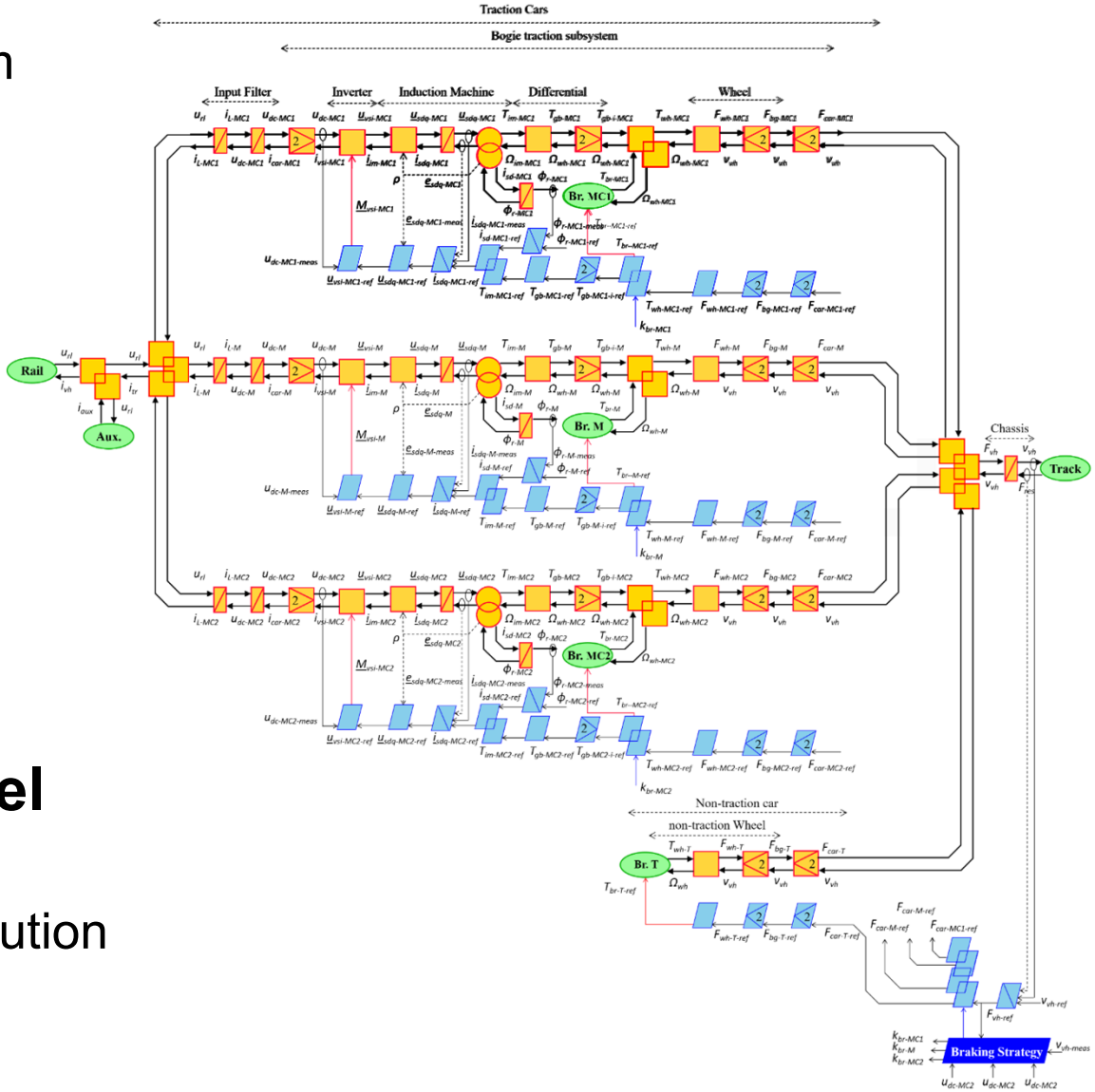
Non-traction car: total of 1

- 2 Bogies (braking)



Traction Subsystem

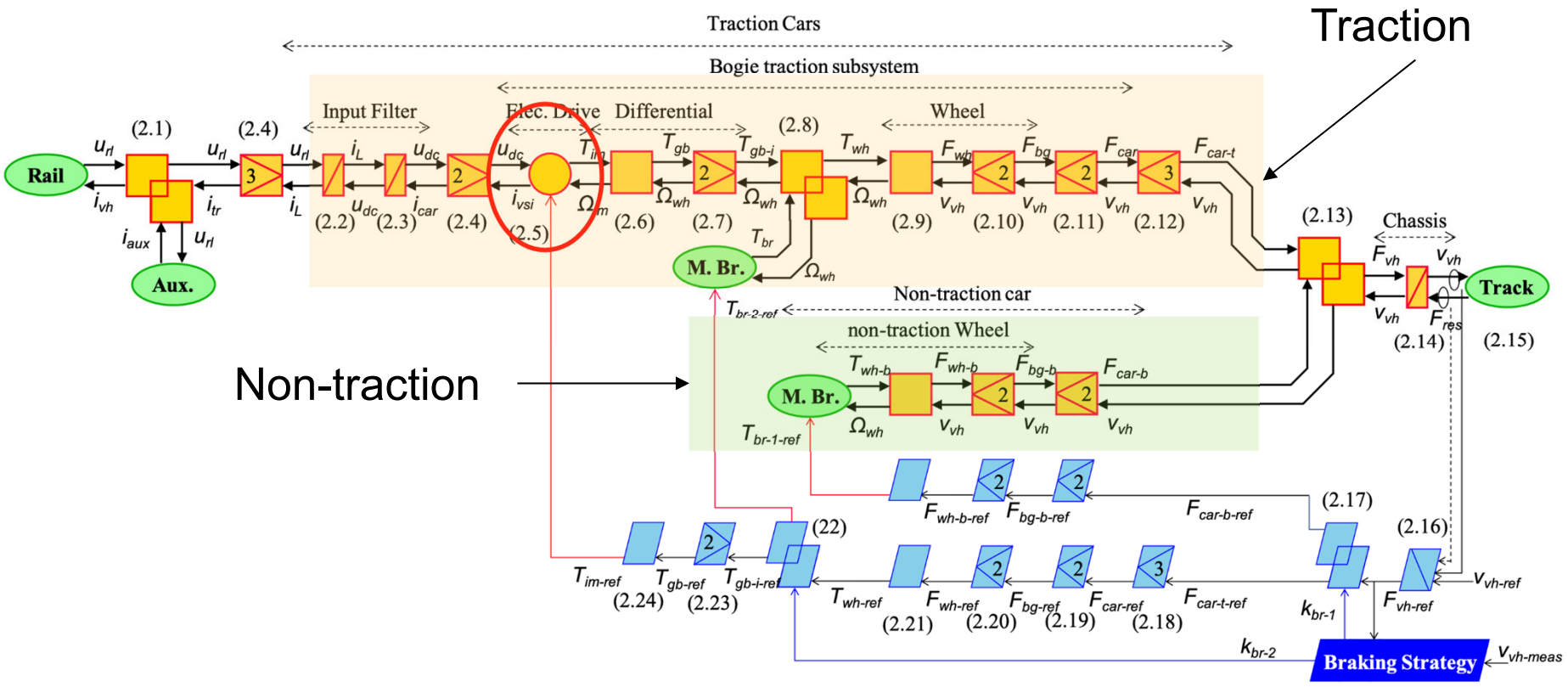




Complete Model

- More complex solution

Quasi static model



- Inverter and machine combined in a single static element
- Constant efficiency is considered
- Error of 2.0% on energy consumption

Subway line study

EMR-based simulation of an electric subway

- Model Validation -

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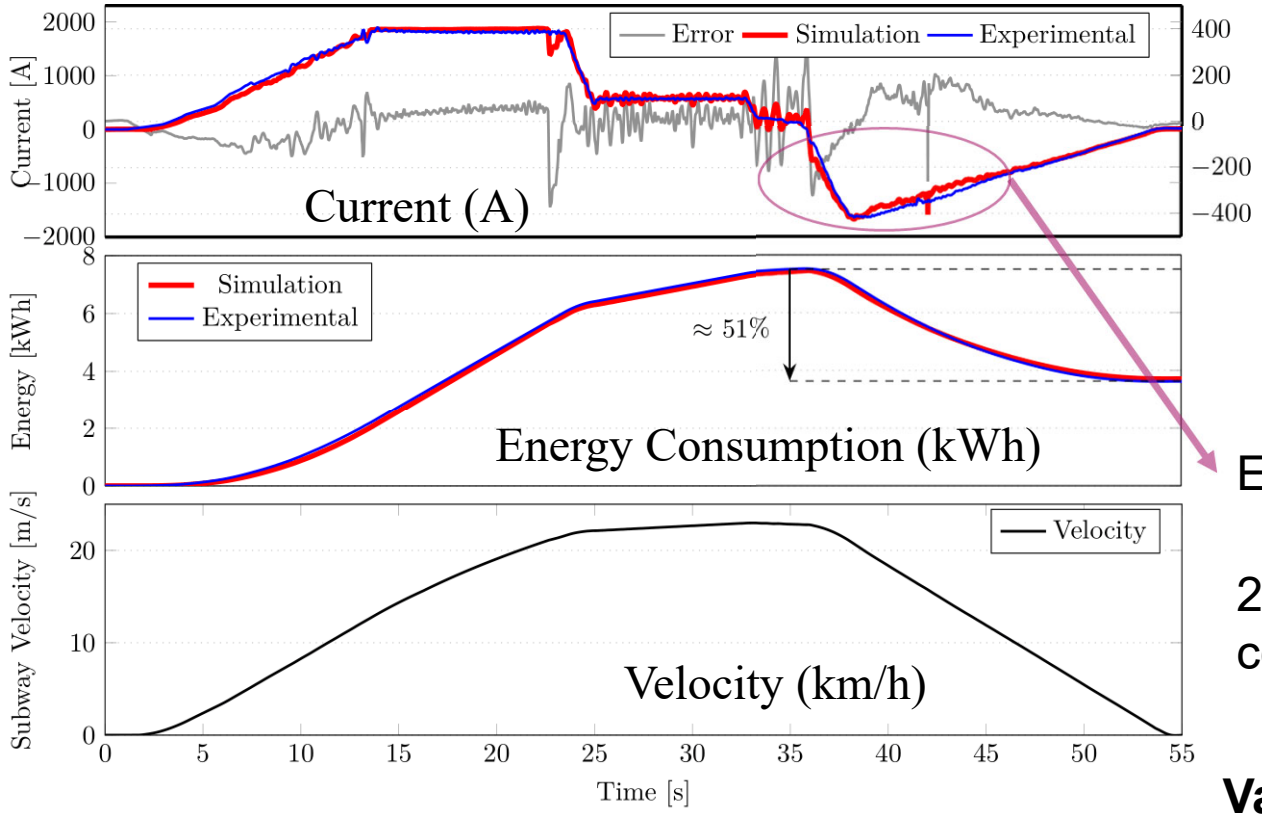
Experimental

Simulation



NMR Test

Energy recovery phase

2.1% difference in energy consumption

Validation of the simulation tool

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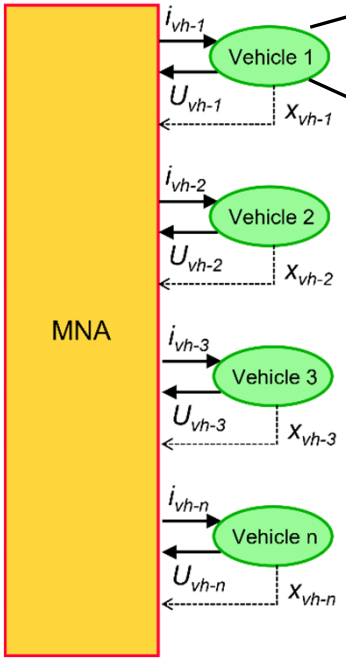
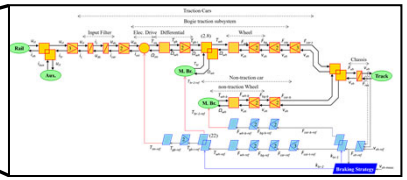
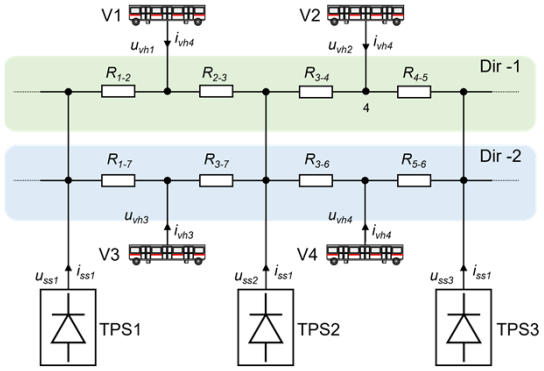
- Carrousel -

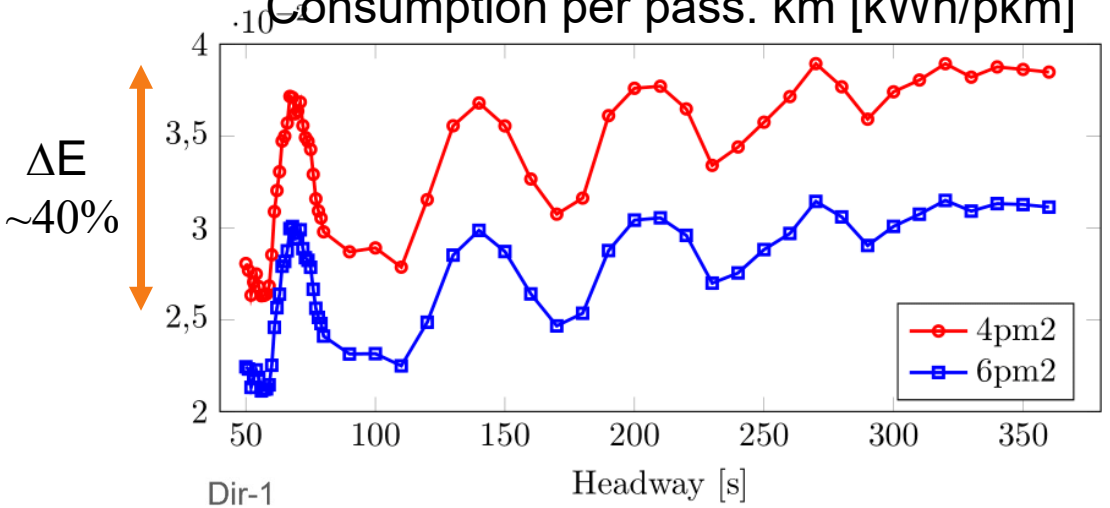




Vehicle model

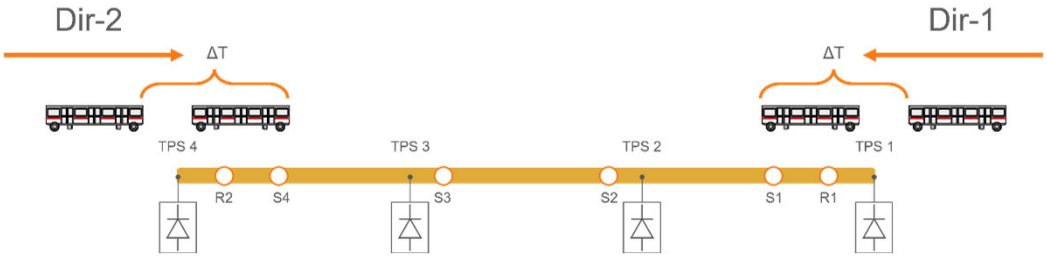


Consumption per pass. km [kWh/pkm]



ΔT – Headway

- Between 50s and 360s
- Simulation time of 25min



Optimization?

Conclusion

- Traction system has been modeled
- Magnitude and profile of simulation current match
- Model validation with energy consumption error of 2.1%
- Error of 2.0% on energy consumption with quasi-static simplification
- Study of the impact of headway – ΔEnergy +/- 40%

- Experimental data validation
- Impose experimental average voltage measurement
- Compare current

- Inputs ●
- DC Bus voltage
- Velocity
- Initial position
- Track topology