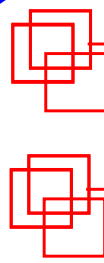


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« **Thermal extension of a traction system for thermal vehicle using EMR** »

Mr. Ludovic Horrein,

L2EP, Univ Lille1, PSA Peugeot Citroën, MEGEVH network

Prof. Alain Bouscayrol,

L2EP, Univ Lille1, MEGEVH network

Dr. Yuan Cheng, Mr. Mehdi El Fassi

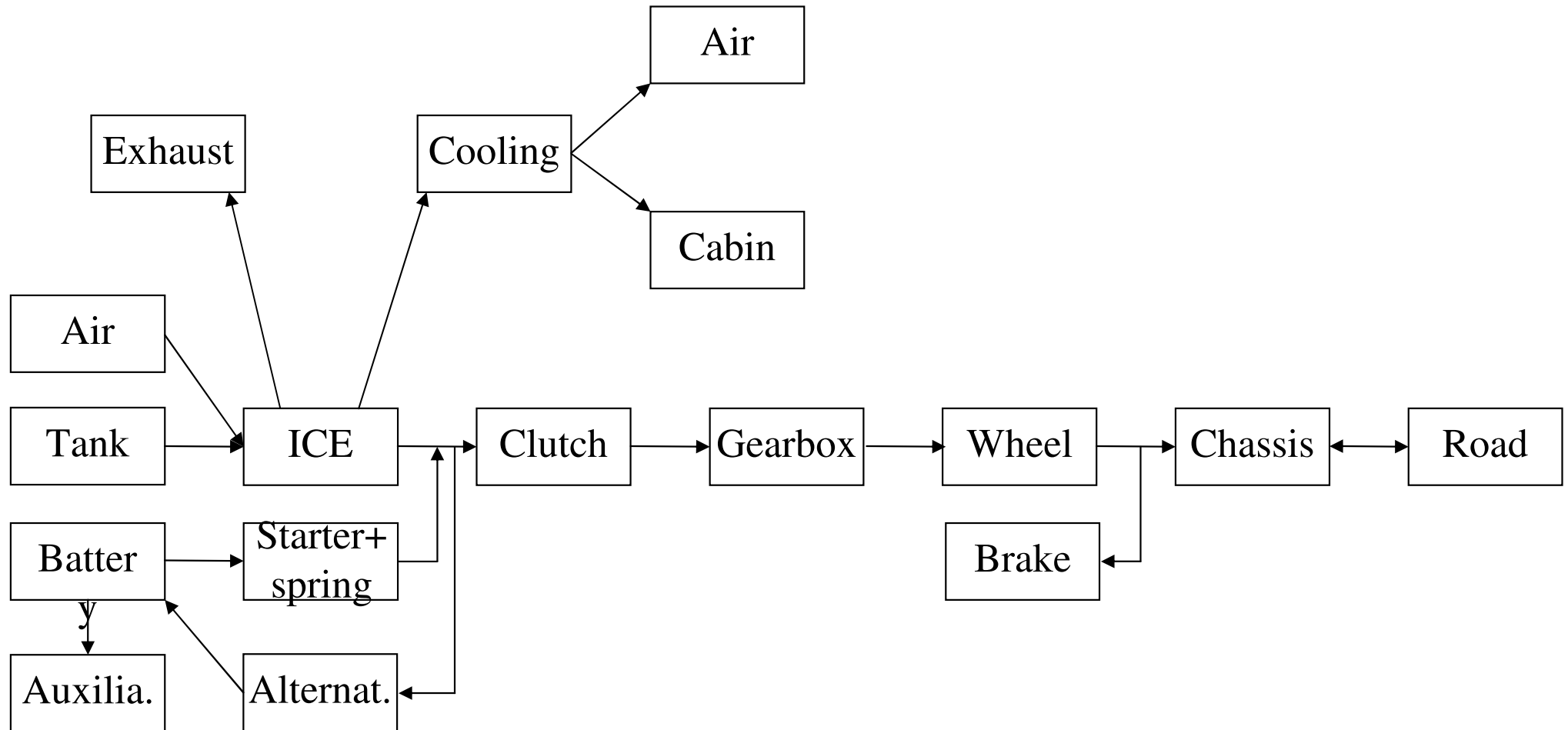
PSA Peugeot Citroën, MEGEVH network

« Thermal extension of a traction system using EMR »

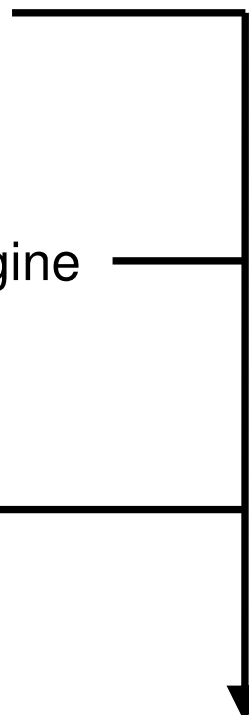
- Context and Objectif -

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Objective: Develop the EMR of a pure thermal vehicle for study the thermal behavior

- Classical model/EMR of a thermal vehicle
 - EMR of the Internal combustion engine
 - EMR of the cooling system
 - Multi-physical description of a thermal vehicle
- 

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« EMR of thermal vehicle »

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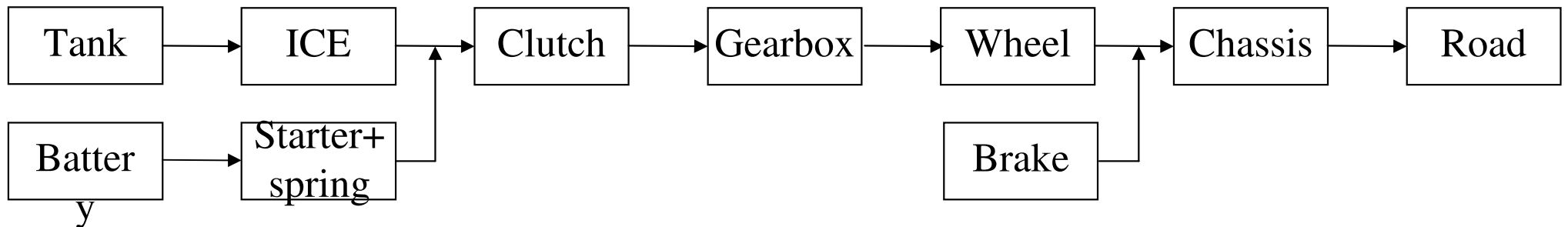
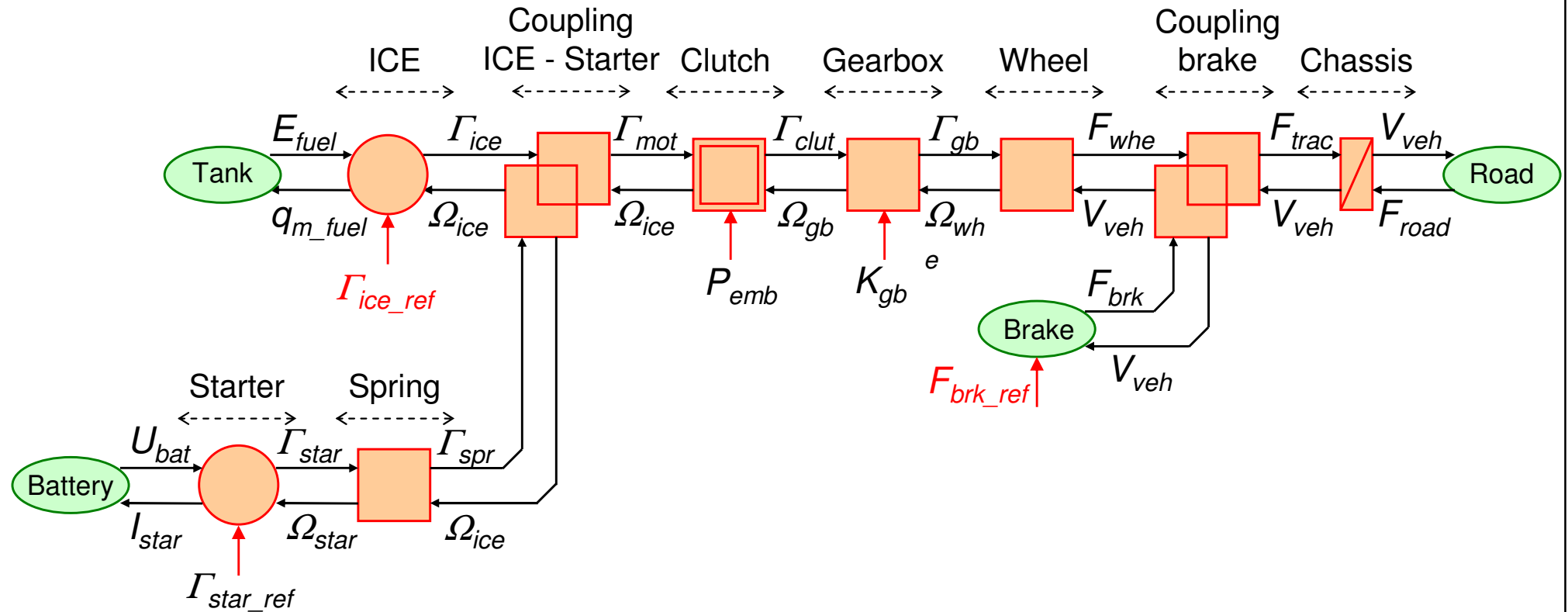


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- Classical EMR of a thermal vehicle -

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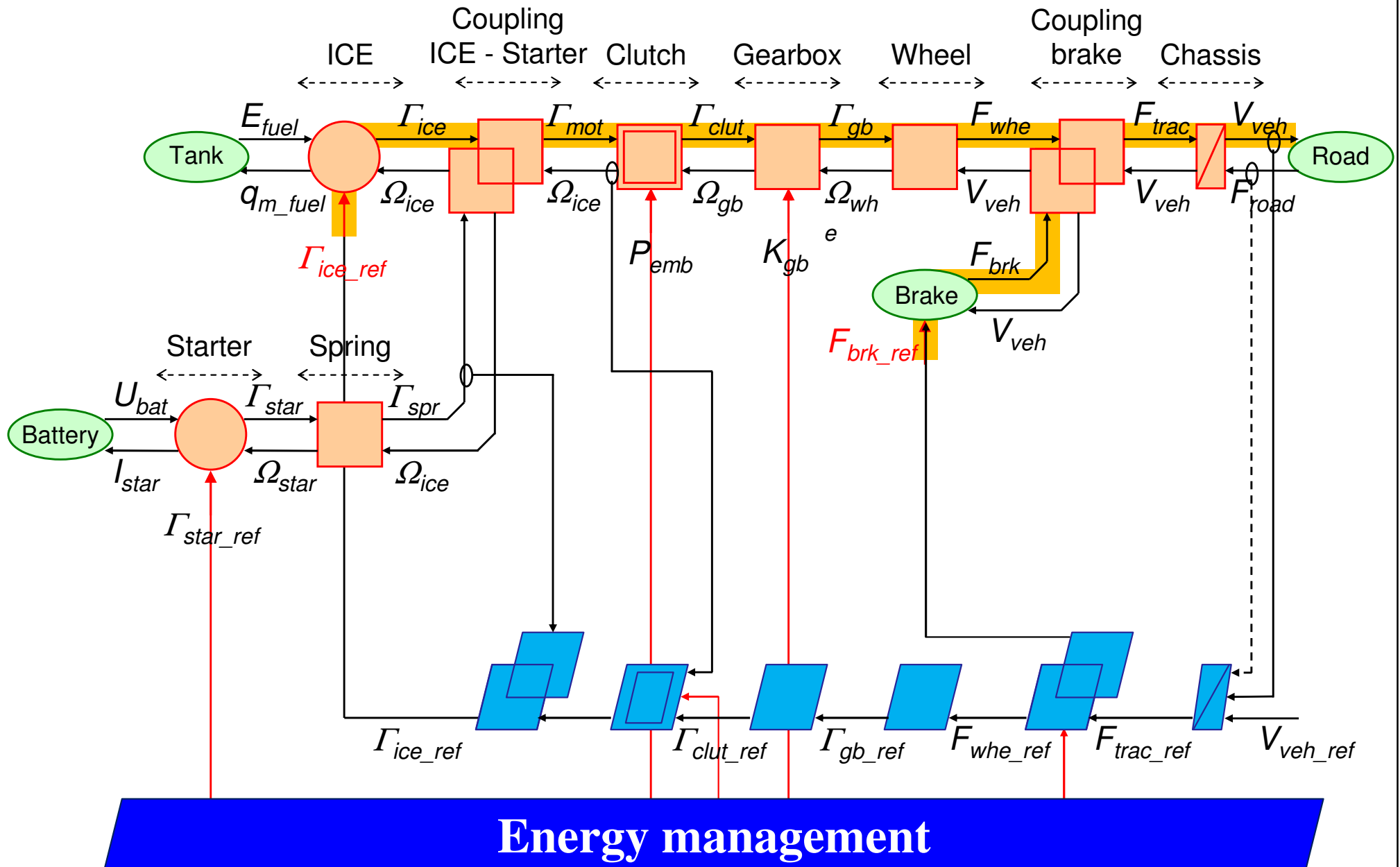


« Thermal extension of a traction system using EMR »

- Control structure of a thermal vehicle -

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« EMR of the Internal Combustion Engine »

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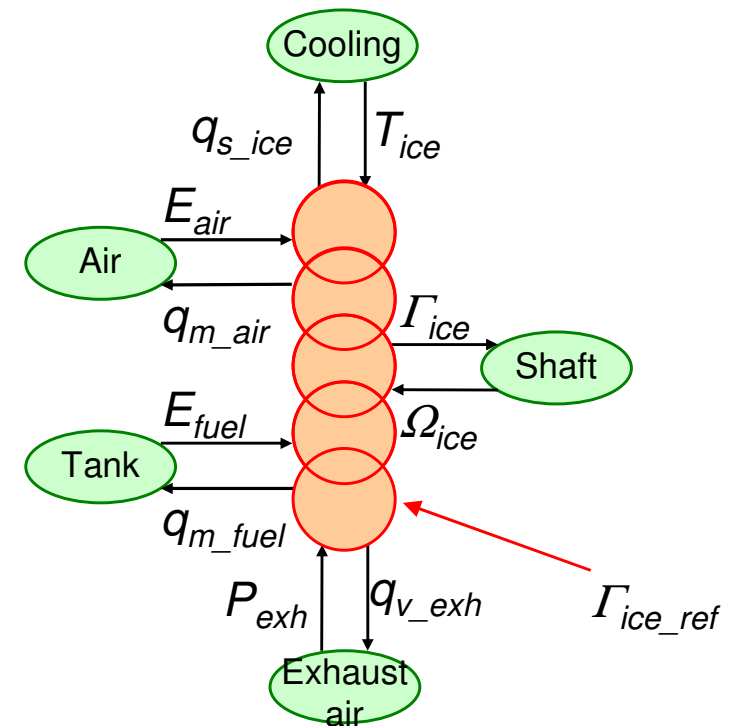
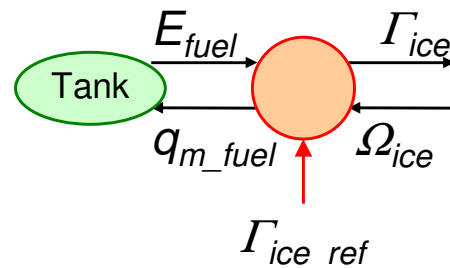
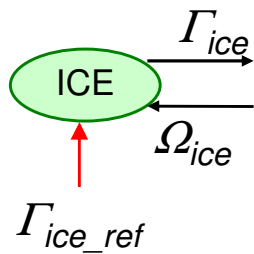
« Thermal extension of a traction system using EMR »

- Several descriptions for one system -

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1 system \neq 1 description



Note: q_m : mass flow rate
 q_v : volume flow rate
 q_s : entropic flow rate

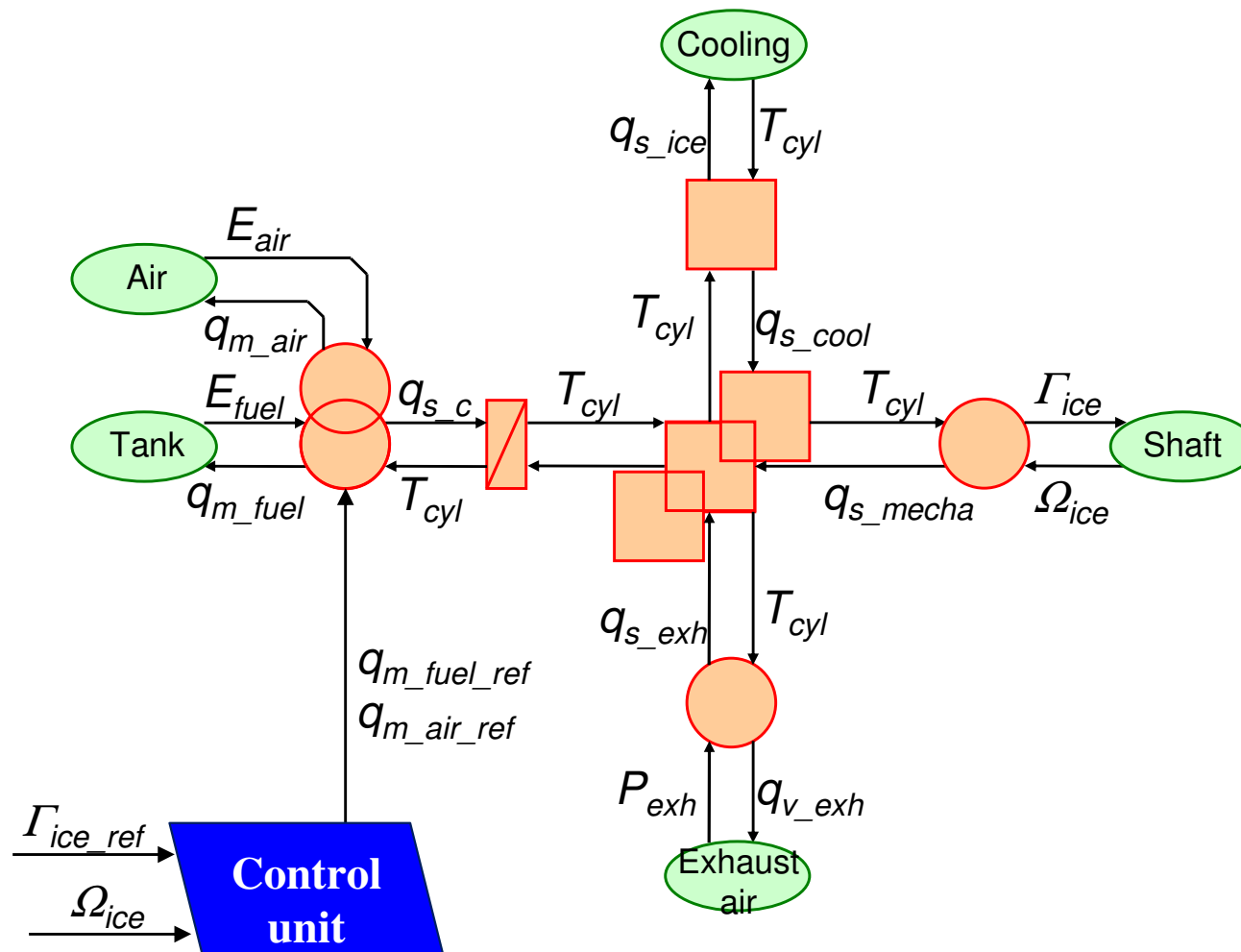
« Thermal extension of a traction system using EMR »

- EMR of one ICE cylinder -

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$$\left(q_{m_air} E_{air} + q_{m_fuel} E_{fuel} \right) - q_{v_exh} P_{exh} - q_{s_ice} T_{ice} - \left(\Gamma_{ice} + \Gamma_{fric} \right) \Omega_{ice} = \frac{d}{dt} U$$

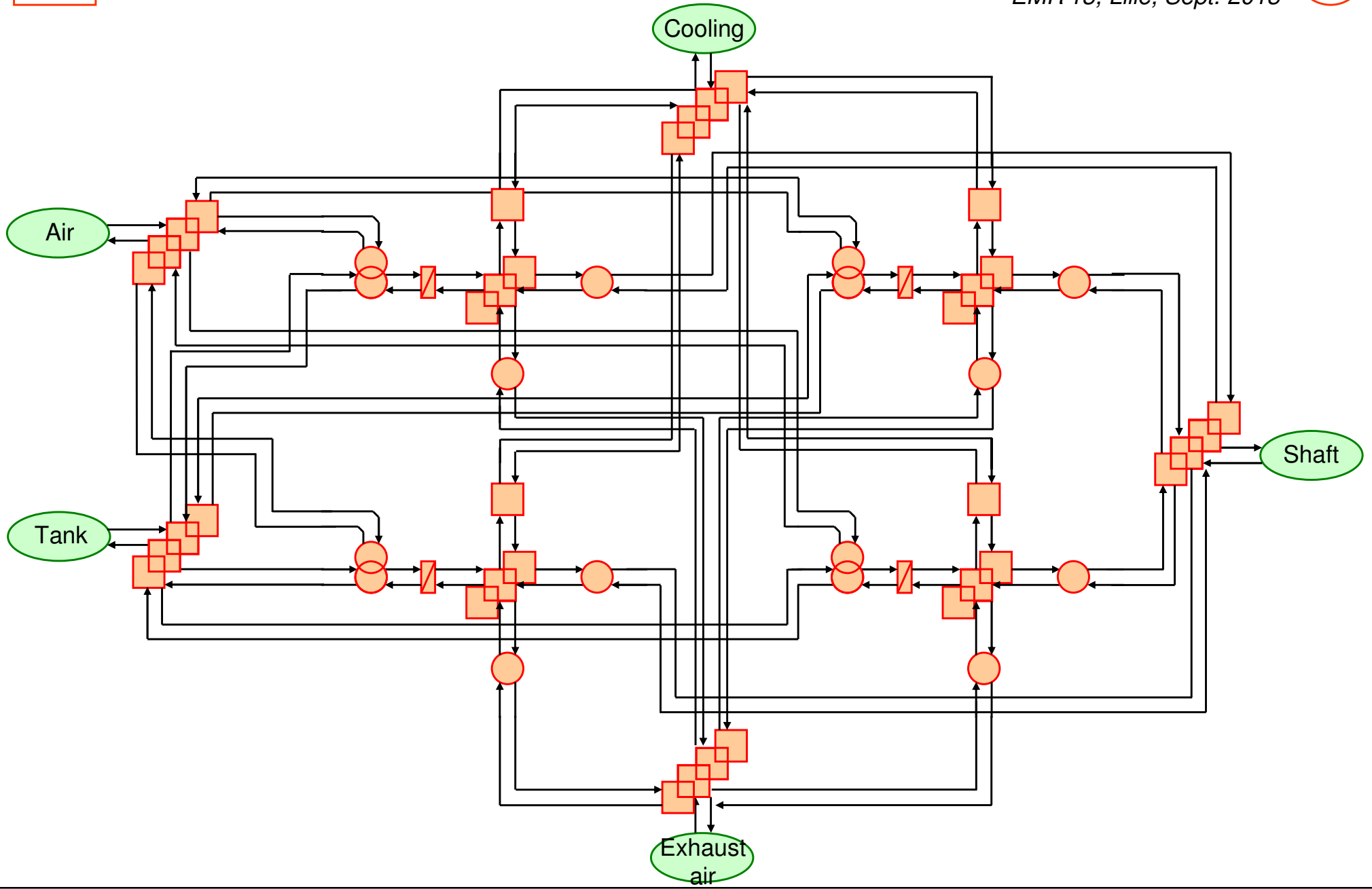


« Thermal extension of a traction system using EMR »

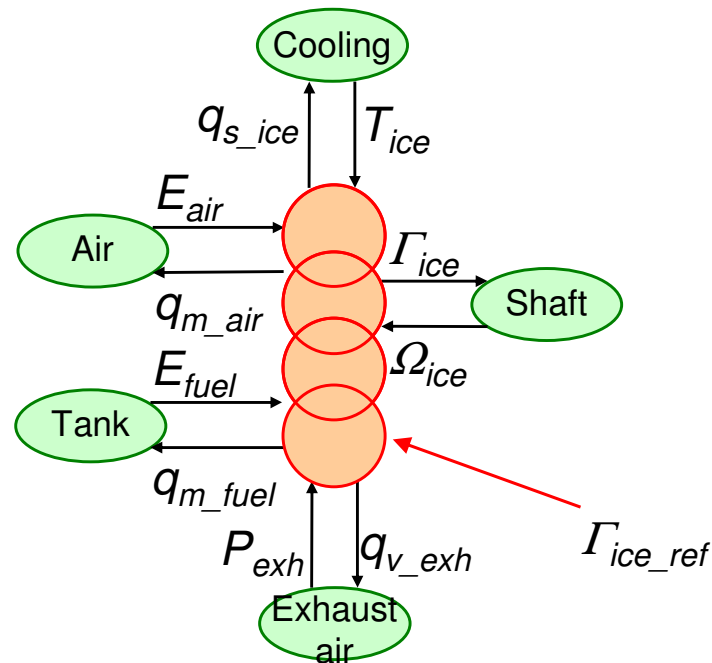
- EMR of a complete ICE -

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- EMR of a complete ICE -

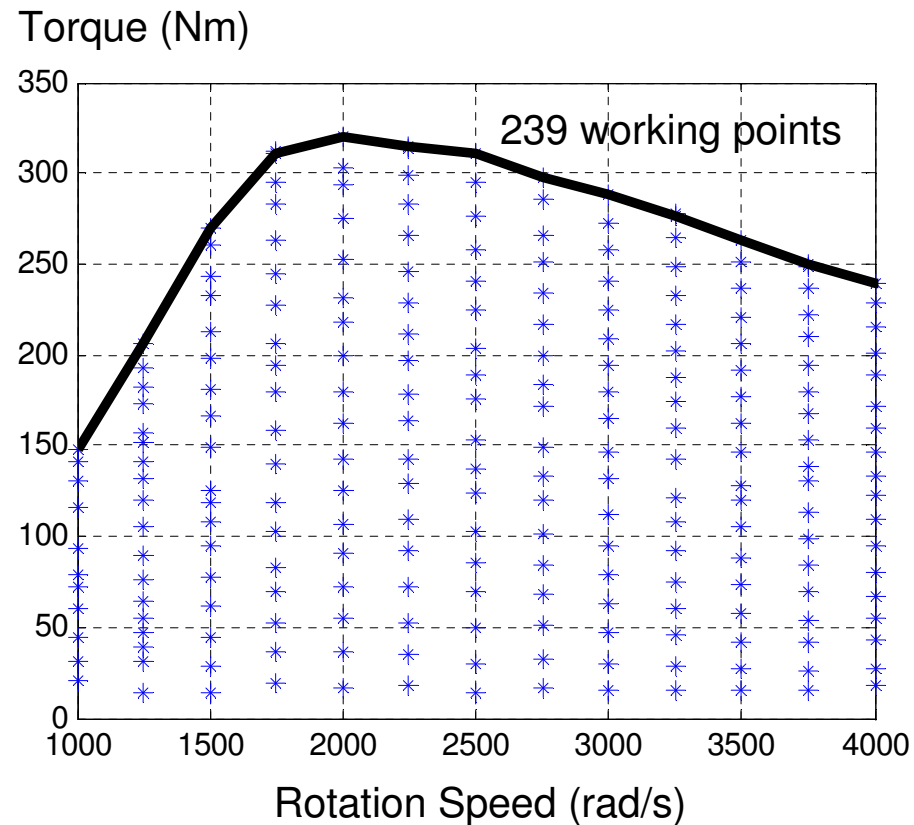


« Thermal extension of a traction system using EMR »

- ICE validation results -

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	$0 \% < \varepsilon < 5 \%$	$5 \% < \varepsilon < 10 \%$	$10 \% < \varepsilon < 20 \%$
Fuel consumption	99,2 %	0,8 %	0 %
Torque	86,2 %	10,5 %	3,3 %
Temperature	50,2 %	34,7 %	15,1 %

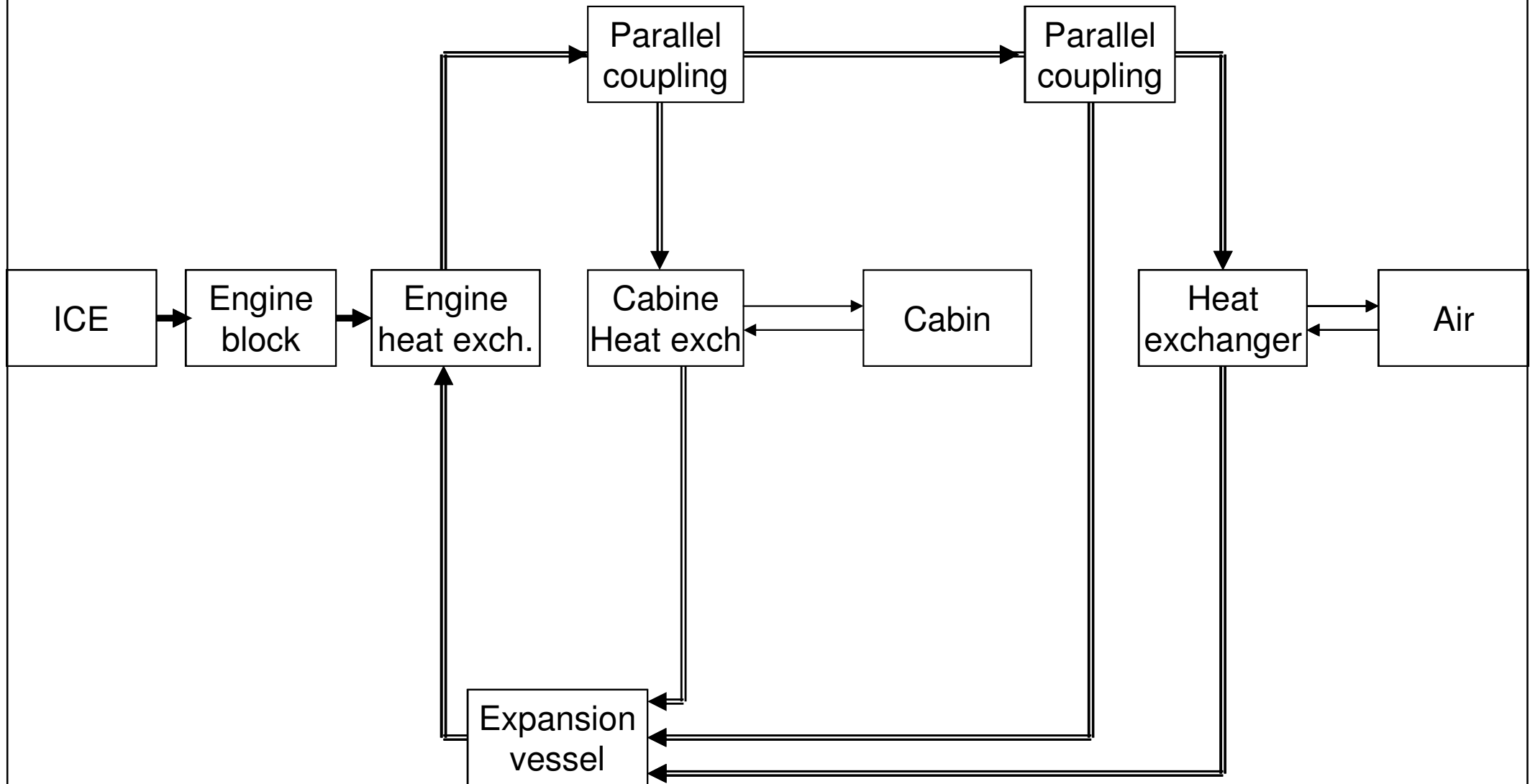
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« EMR of the cooling system »

- Cooling system structural description -

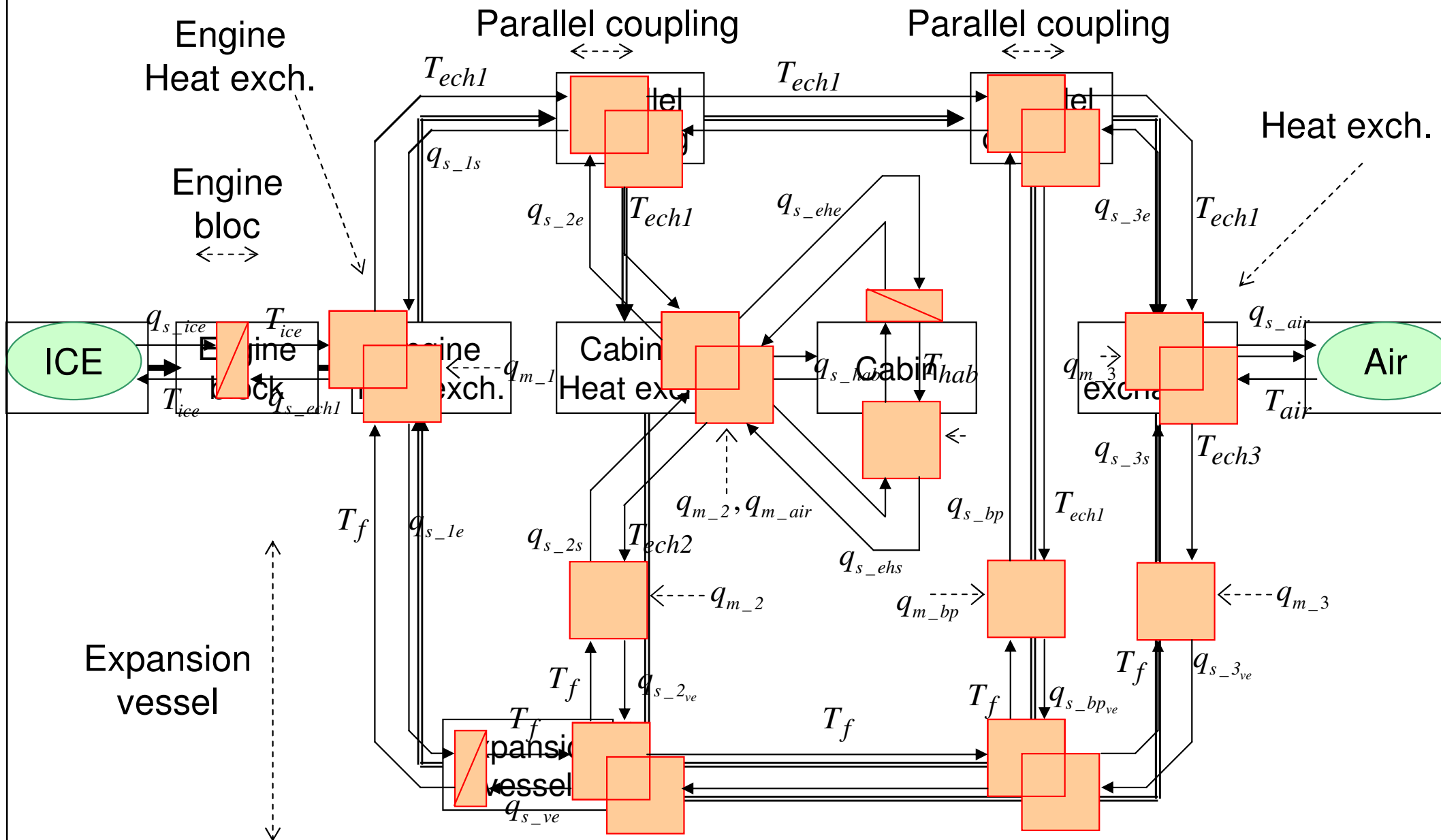


« Thermal extension of a traction system using EMR »

- EMR of the cooling system -

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« EMR of the thermal vehicle with thermal exchange »

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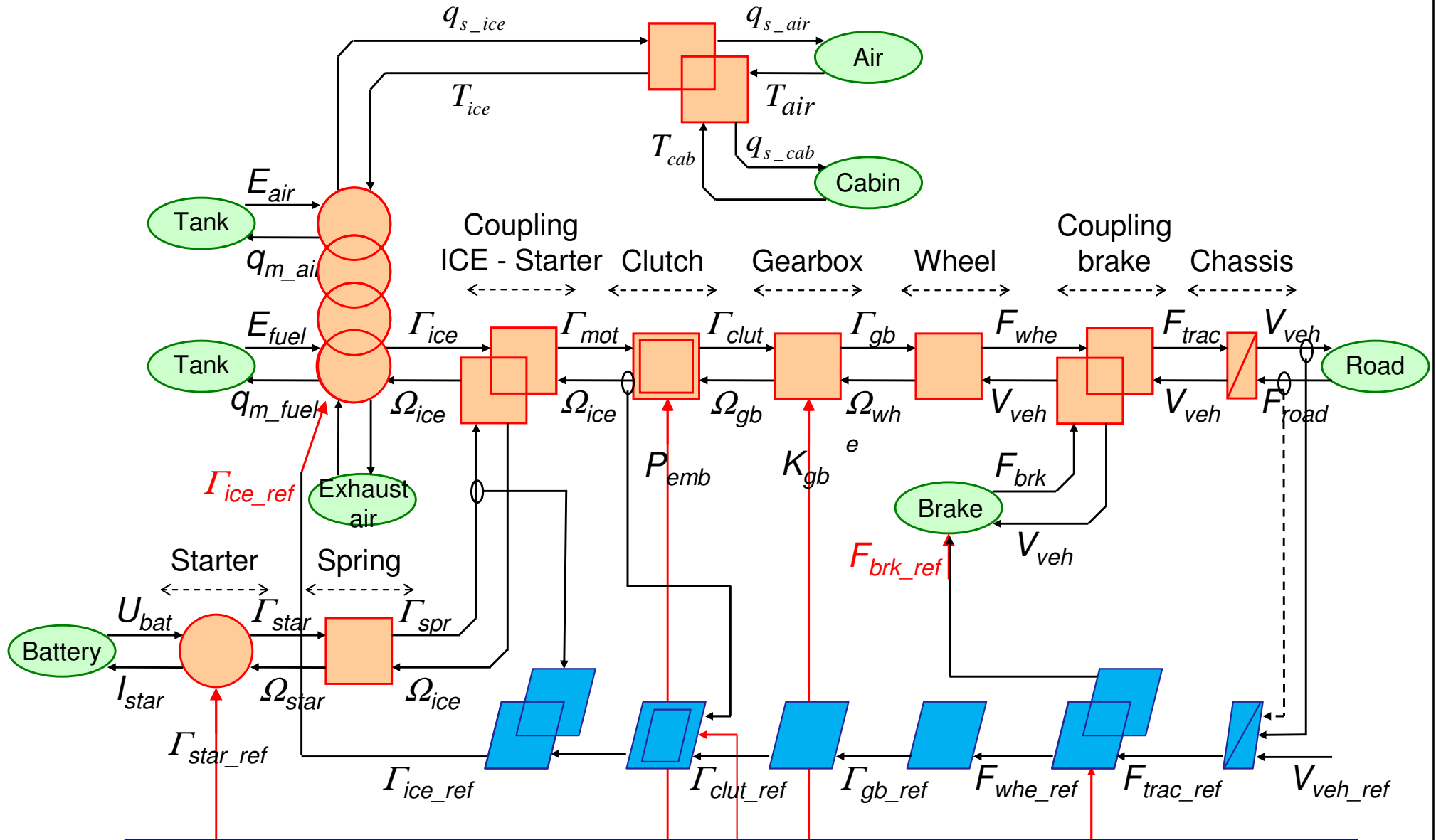


« Thermal extension of a traction system using EMR »

- Multi-physical EMR of the thermal vehicle -

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Energy management

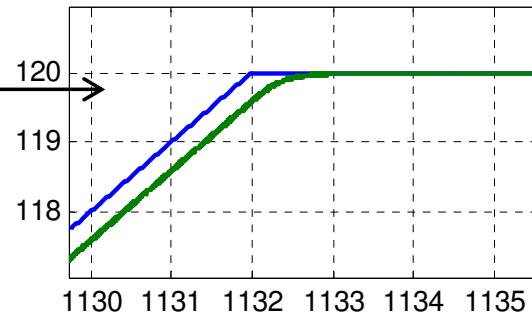
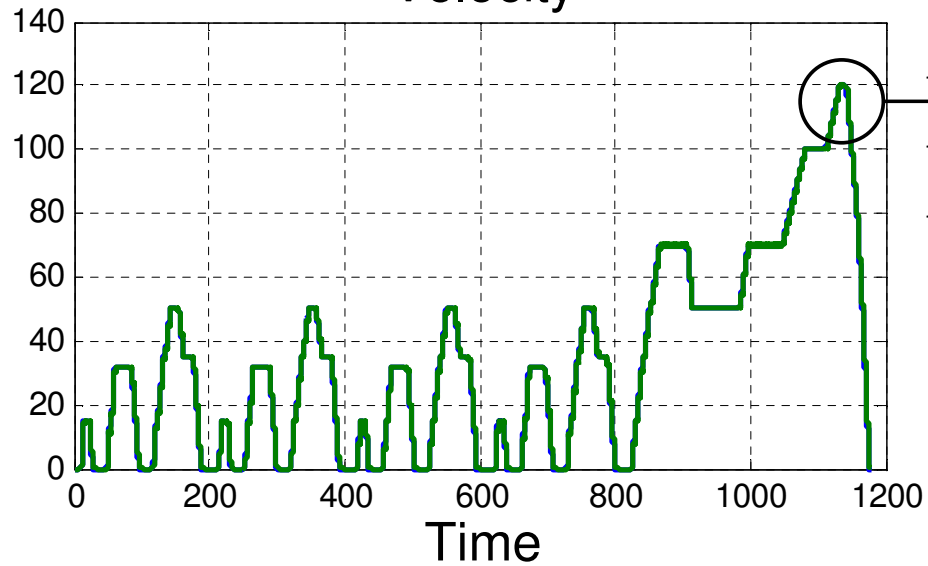
« Thermal extension of a traction system using EMR »

- Simulation results (1) -

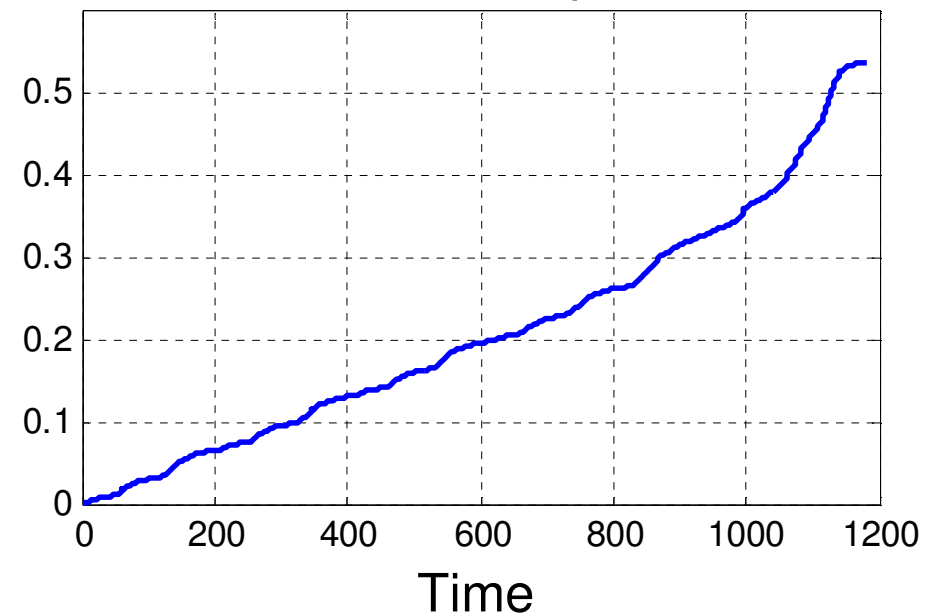
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Velocity



Fuel consumption

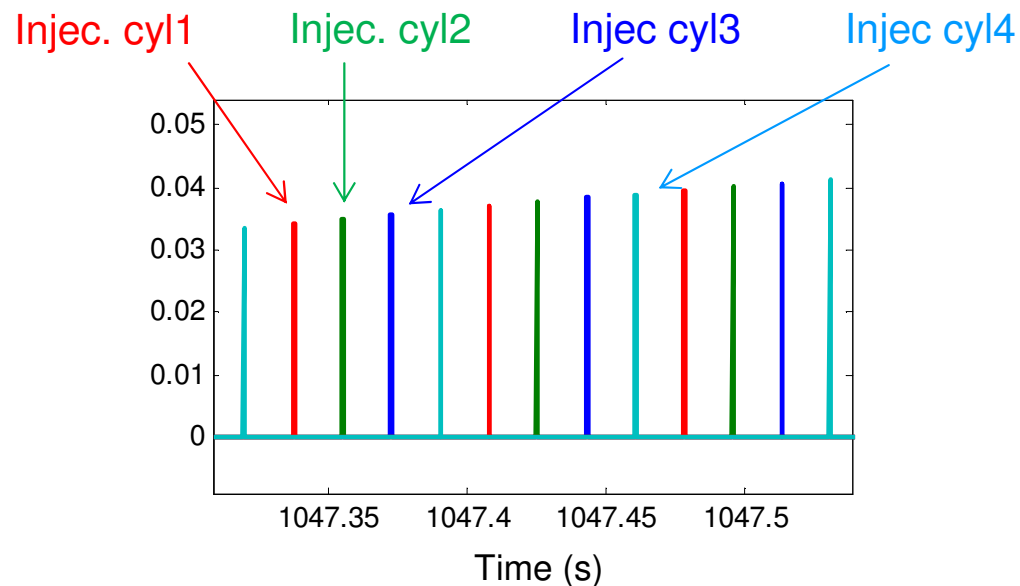
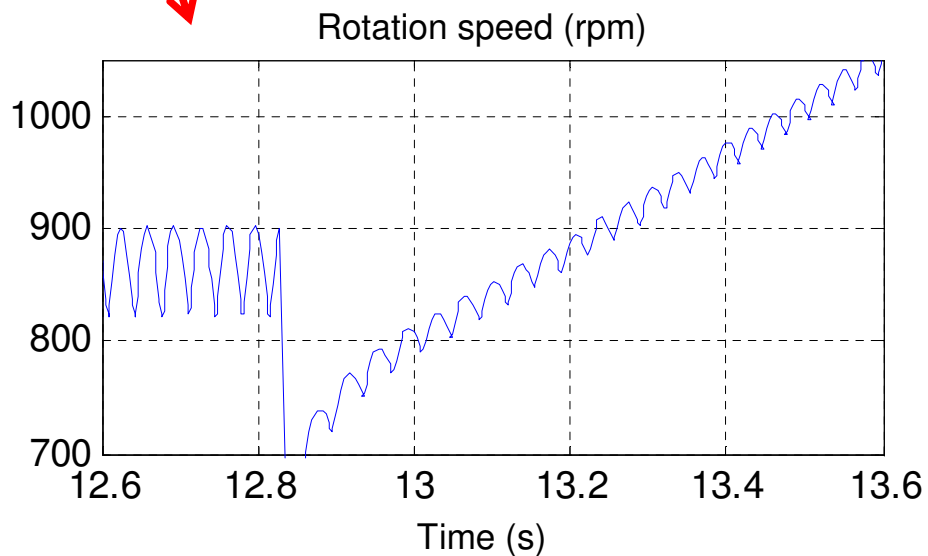
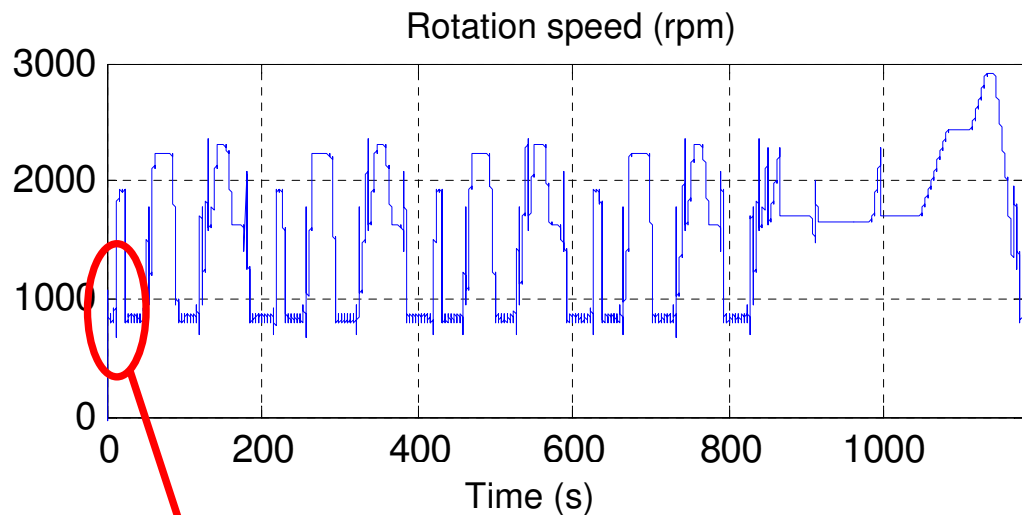


« Thermal extension of a traction system using EMR »

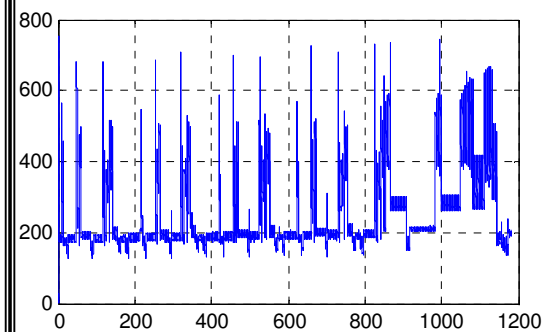
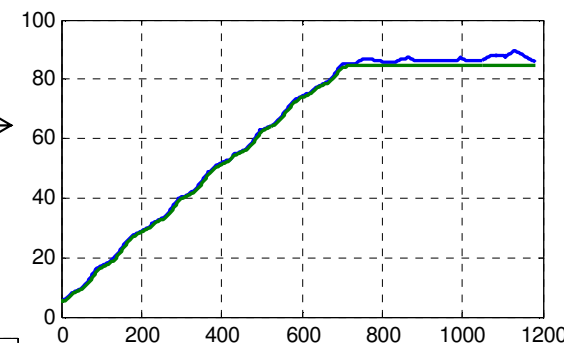
- Simulation results (2) -

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Engine temperature (°C)
Fluid temperature (°C)



Exhaust gases temperature (°C)

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« Conclusion & Perspectives »

A single tool to describe a complex system

A multi-physical extension

More details on the power flow => thermal analysis

Important computation time => model reduction of the ICE ?

Insert the 'air conditioning' model

Towards a thermal energy management