Domenico Perna Tutor: Andrea Del Pizzo¹ – co-Tutors: Luigi Fratelli² – Roberta Schiavo² 1) University of Naples Federico II, DIETI 2) Hitachi Rail Italy XXIX Cycle - II year presentation Improvement of efficiency and reliability in Light Railway Vehicles through estimation algorithms based on multitechnology integration **Rail Transport** Systems: Need to introduce new technologies

able to ensure high efficiency and reliability

Research Activities:

Idea:

Streetcars are sometimes required to cover distances of several hundreds meters in catenary-free mode to satisfy two main requirements:

safety, for moving vehicles to a station in case of catenary line fault;

2) conservation of old towns, avoiding the

presence of catenary in historical places. The idea was to find a method for properly sizing a supercapacitor storage system able to supply the energy required by a real streetcar along an assigned track in catenary –free operations.

Methodology:

Idea:

A traction vehicle is usually requested to perform a route operating in sequence: acceleration, cruise, coasting and braking phases. As in urban travel the distance between two consecutive stops is short, so cruise operation is limited in favor of traction and deceleration phases. Operation in coasting and braking allows both energy-saving, as slow down is obtained in inertial either regenerative way. Two vehicles, equipped with IM and PMSM have been compared from the energetic point of view by focusing attention to a deceleration part of speed time diagram consisting of inertial and braking phases, in order to achieve max efficiency.

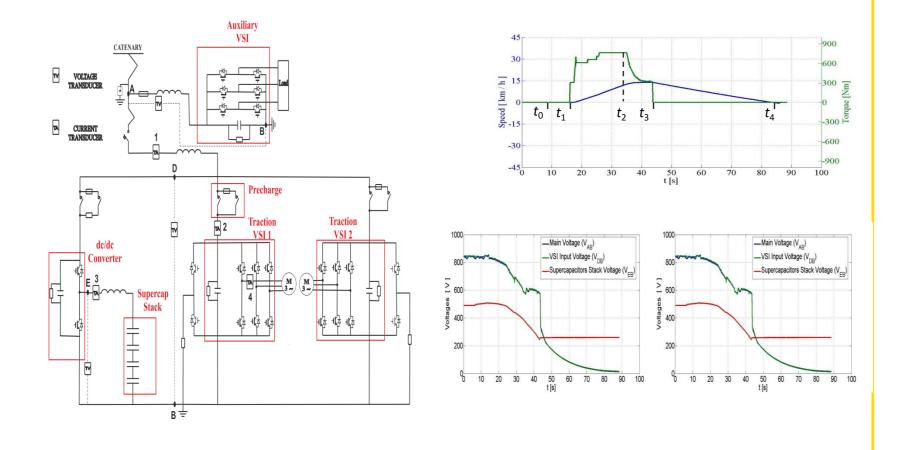
Methodology:

Idea:

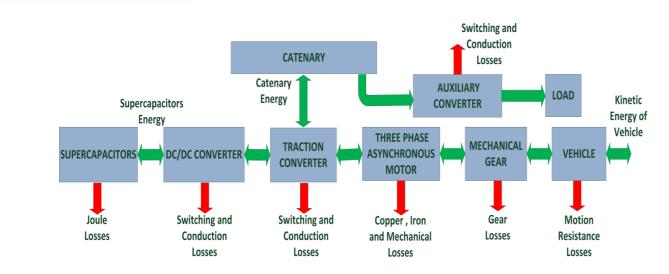
Speed sensorless control represents an awkward challenge for traction railway vehicles, due to presence of slip and slide conditions, anti-roll back conditions, zero speed operations and repowering operation at high speed. Implementation of speed sensorless control in high power drives for railway propulsion systems, brings major reliability and cost reduction. An indirect knowledge of speed signal, delivered on modern high-speed vehicle network could be beneficial in some typical traction applications.

Methodology:

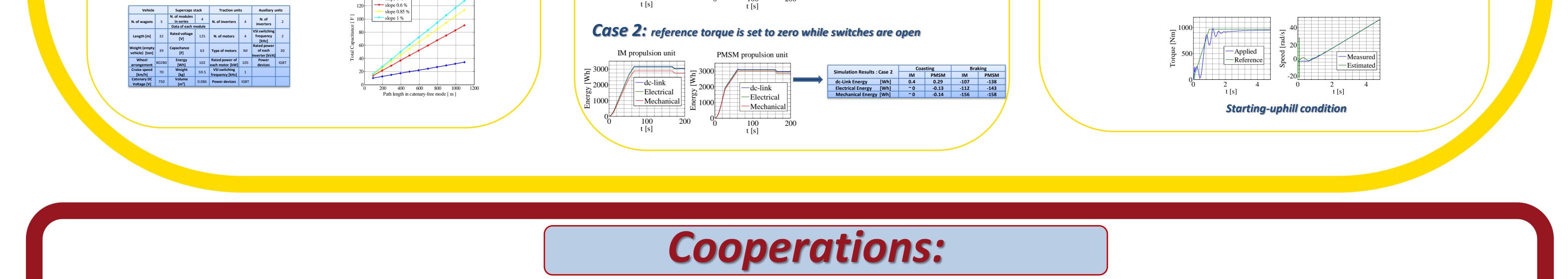
Experimental tests have been carried out on an experimental streetcar vehicle, with the aim to evaluate energy losses in the various sub-systems:

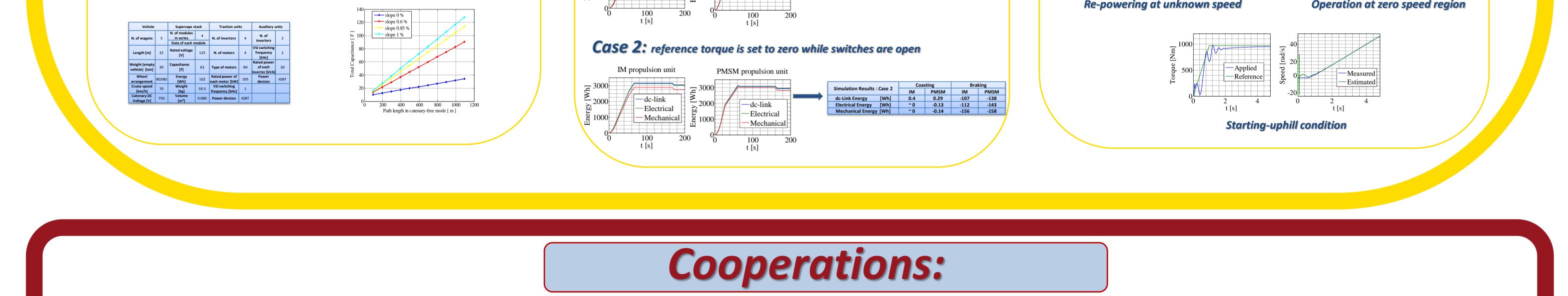


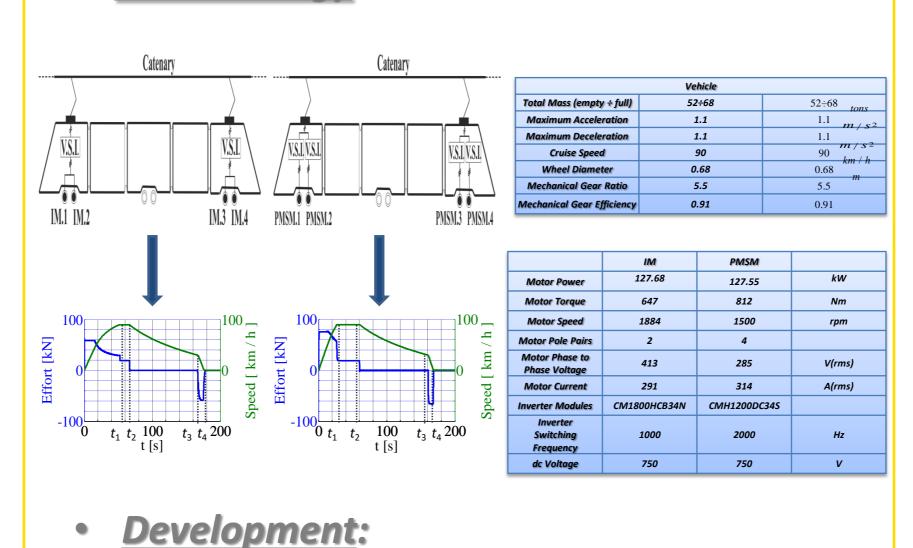
Development:

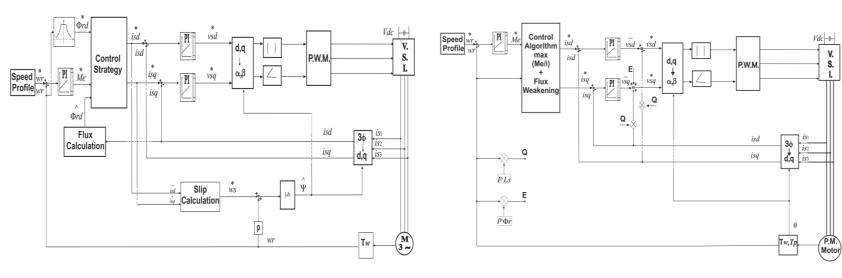


Results:

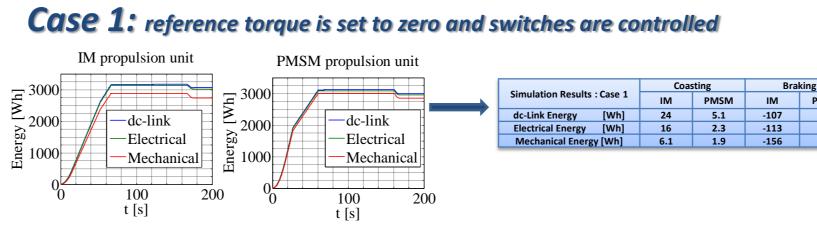




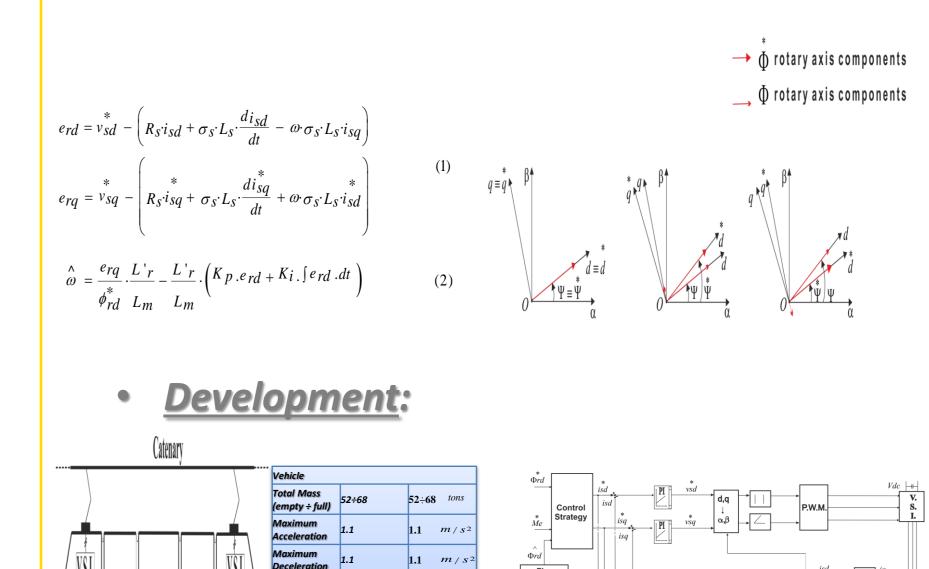




<u>Results (achieved at present):</u>



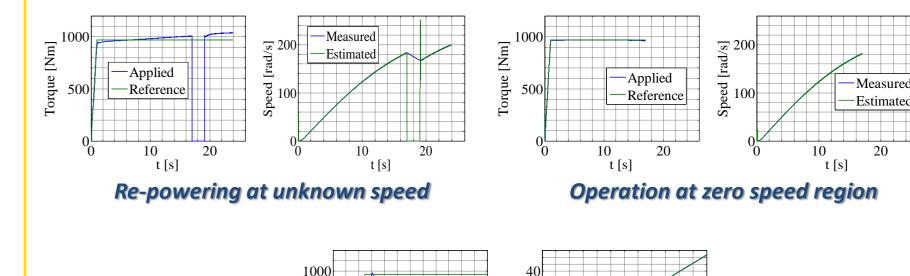
propulsion unit	PMSM propulsion unit



Results (achieved at present):

Mechanical Gear Efficiency 0.91

M1 M2

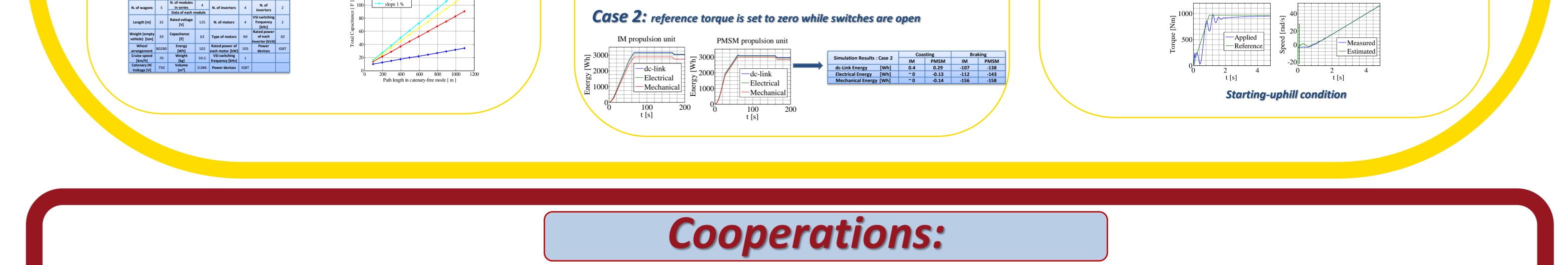


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Speed Estimator +

Integrated System

jdt Ý



• Hitachi Rail Italy – a Hitachi Group

Group of Power Converters, Electrical Machines and Drives – DIETI - UNINA

Next Developments :

- Determine a Speed Sensorless Control specific for Rolling Stock
- Determine an algorithm to optimize energy efficiency of speed profile for IM or PMSM vehicles and their drive (ecodrive)