

Final Event
24-25th of May 2022

Evaluation Group

Inland Freight Vessel Hybridization



Powerful Advanced **N**-Level Digital Architecture
for models of electrified vehicles and their components

Fabian Amoros



In collaboration with L2EP and IRENav



www.project-panda.eu



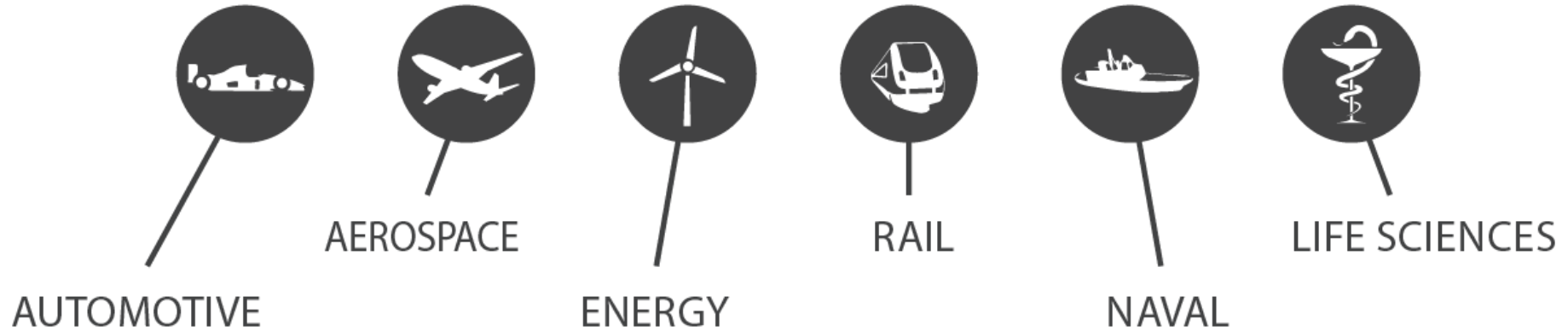
Segula Technologies

Segula Technologies



GLOBAL ENGINEERING GROUP

SERVING THE COMPETITIVENESS OF ALL MAJOR INDUSTRIAL SECTORS



10 000+
EMPLOYEES

30+
COUNTRIES



140+
LOCATIONS

300+
CUSTOMERS



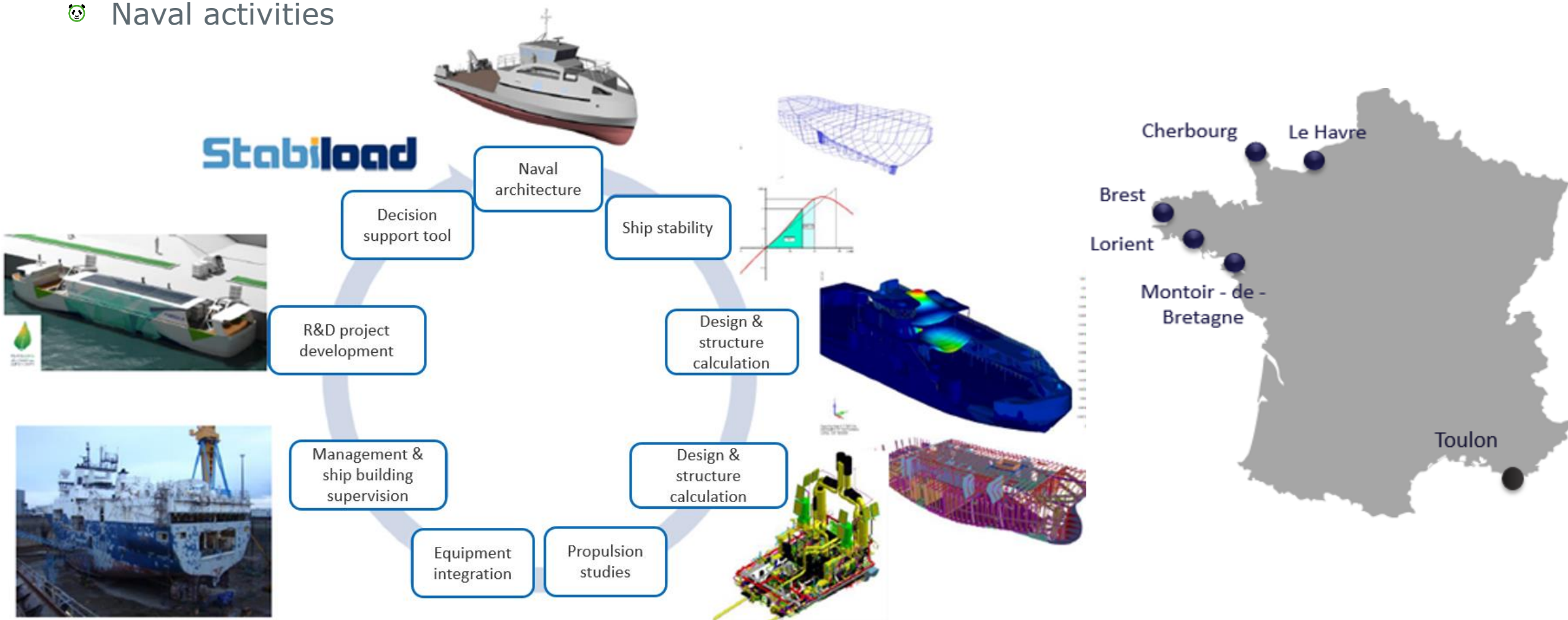
200+
R&I PROJECTS
EVERY YEAR



Segula Technologies



Naval activities



Series Hybrid Engine - Electric Ship

Series Hybrid Engine – Electric Ship



🐼 Project : Retrofit an old Diesel Vessels: The Sydney

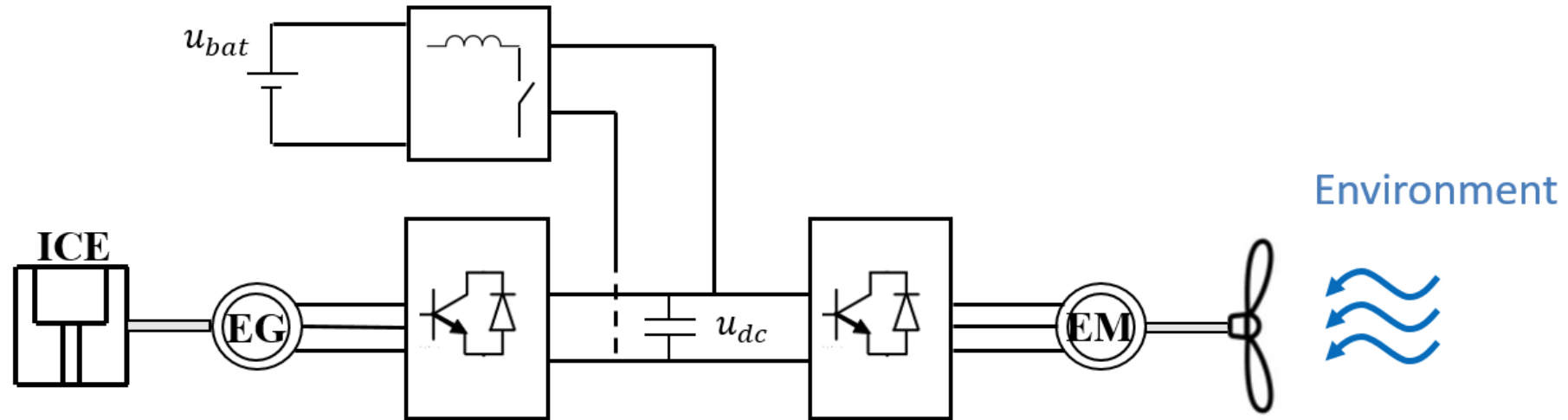


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🐼 Objectives

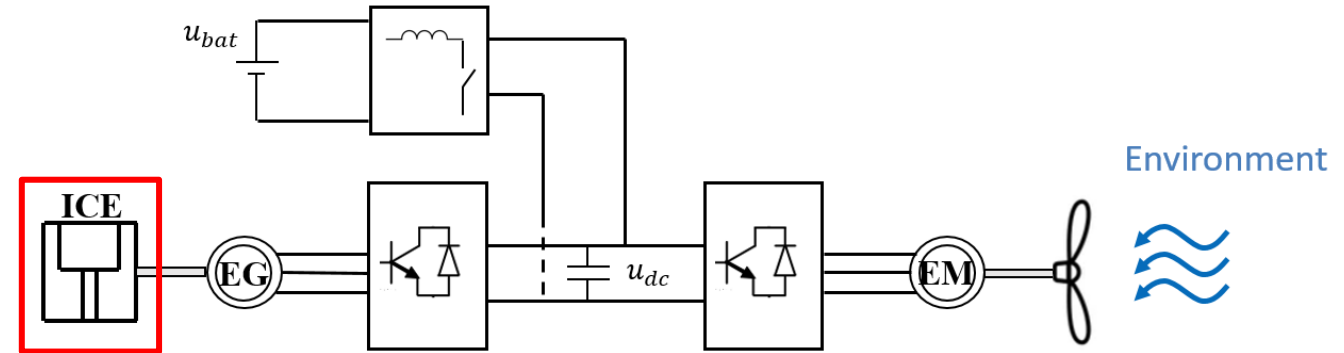
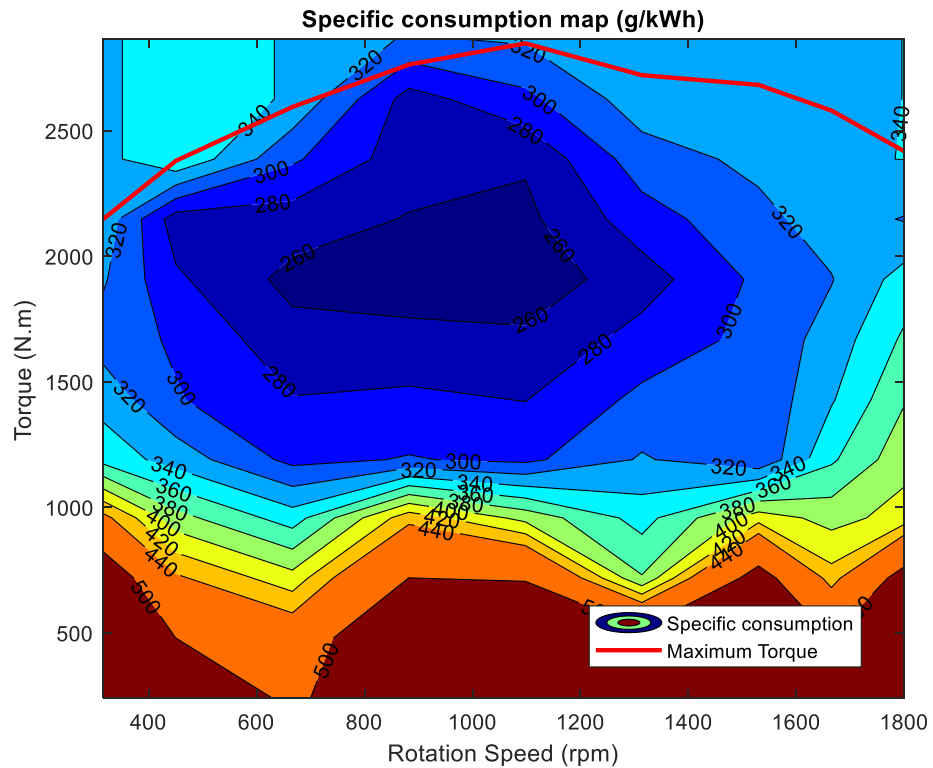
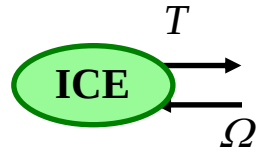
- 🐼 Show the feasibility of the hybrid retrofit process
- 🐼 Gas Technology demonstrator
- 🐼 The Simulator will be used to size the propulsion

Series Hybrid Engine – Electric Ship



Architecture of the Hybrid vessels

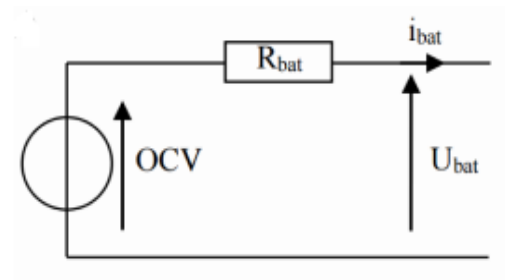
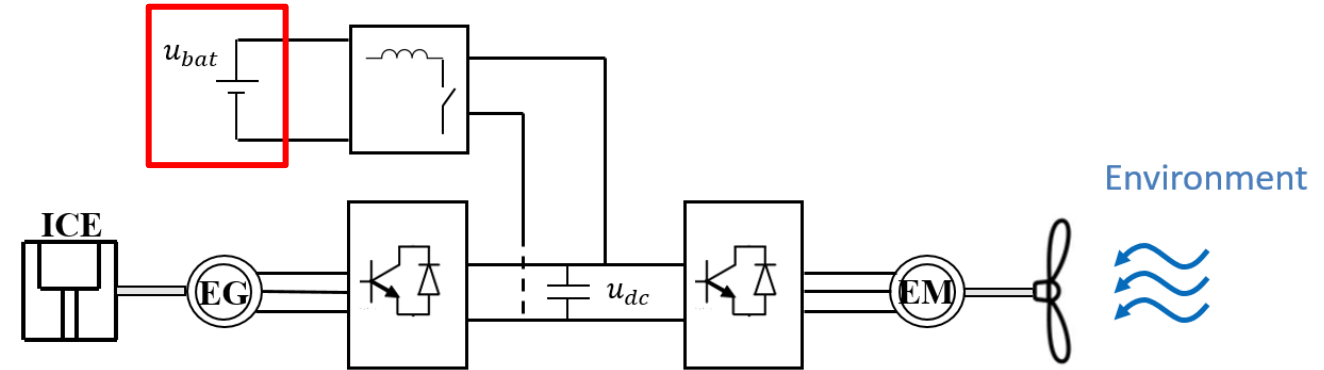
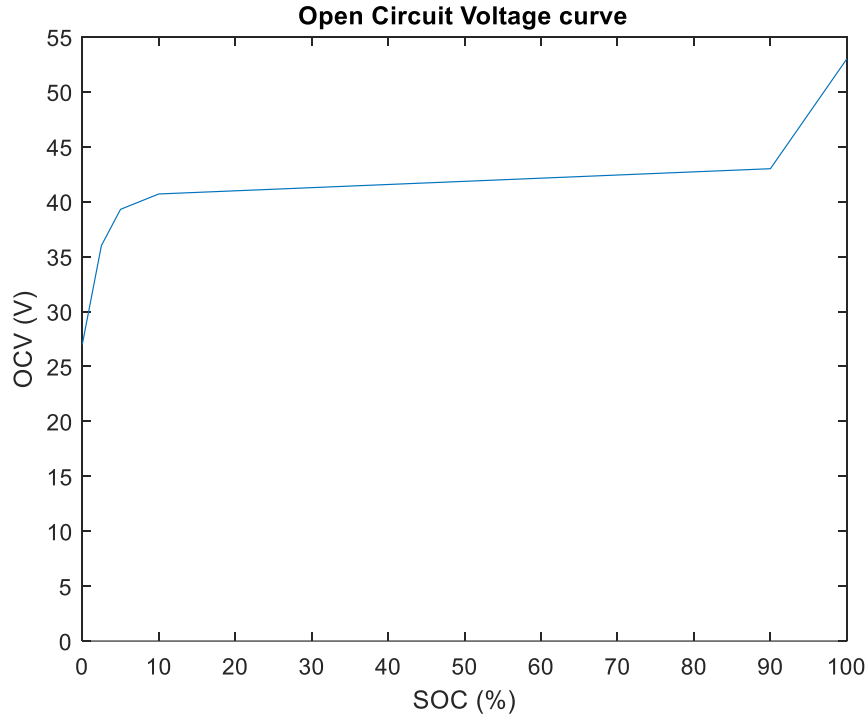
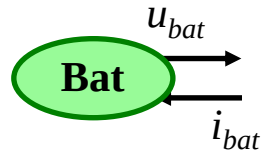
Series Hybrid Engine – Electric Ship



Internal Combustion Engine

- Specific consumption cartography

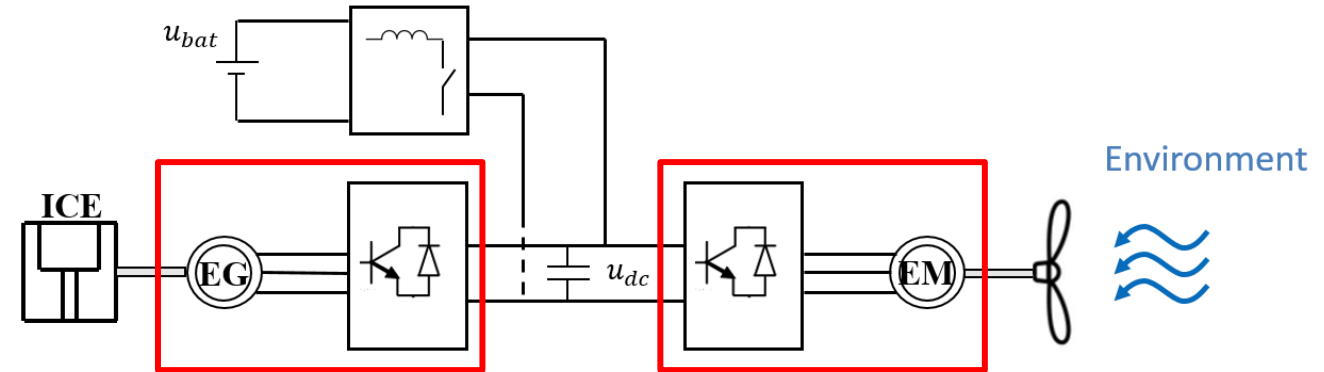
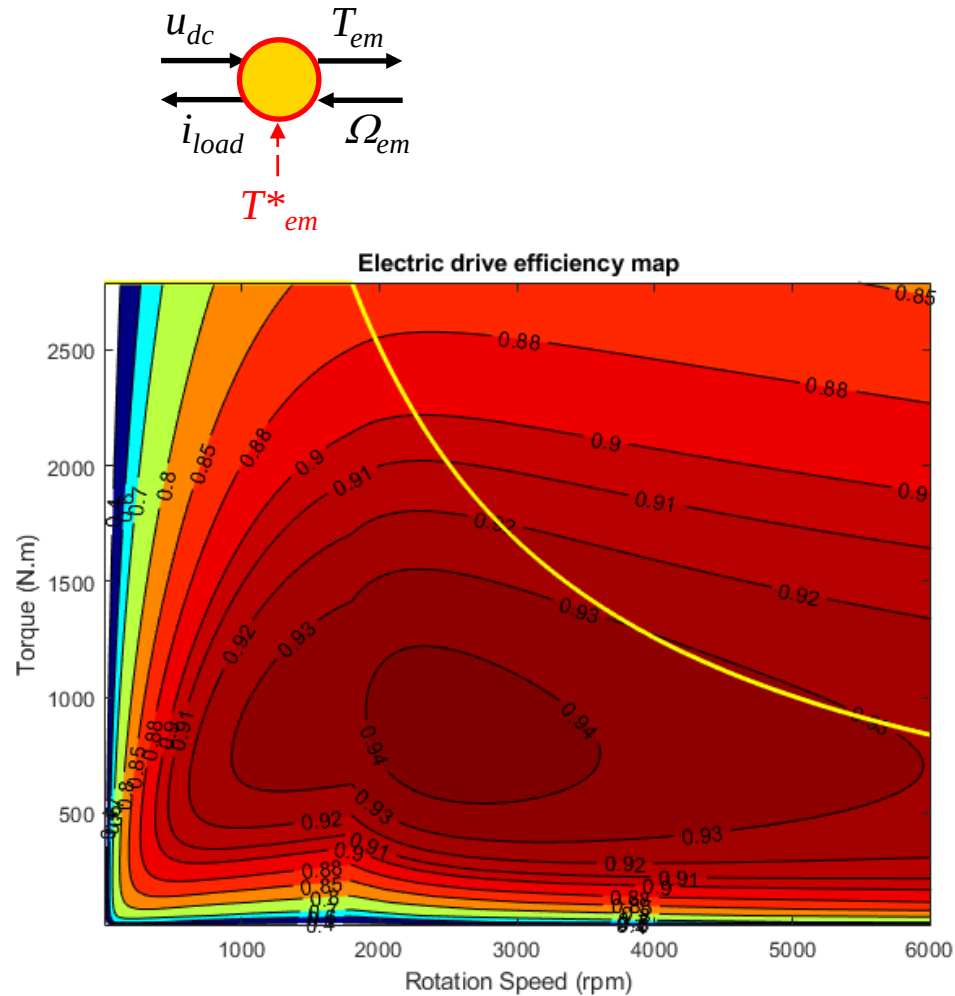
Series Hybrid Engine – Electric Ship



Battery

- 0 order model

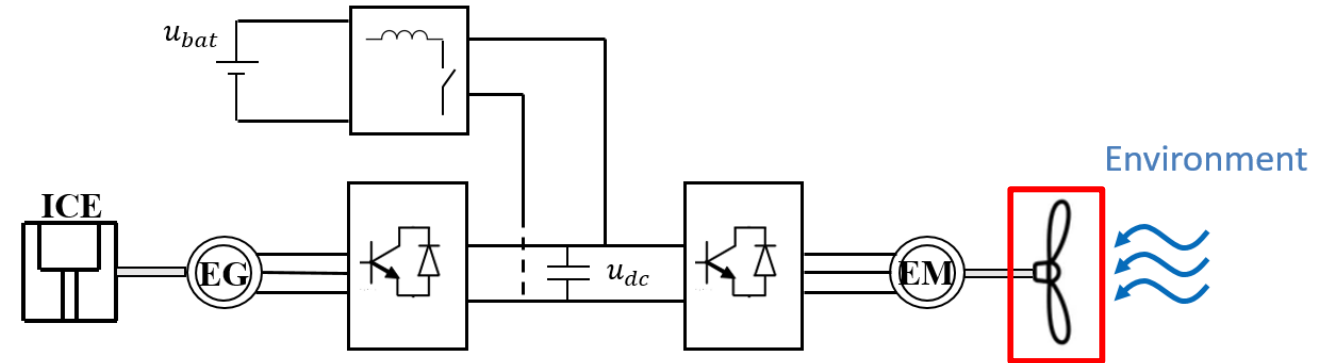
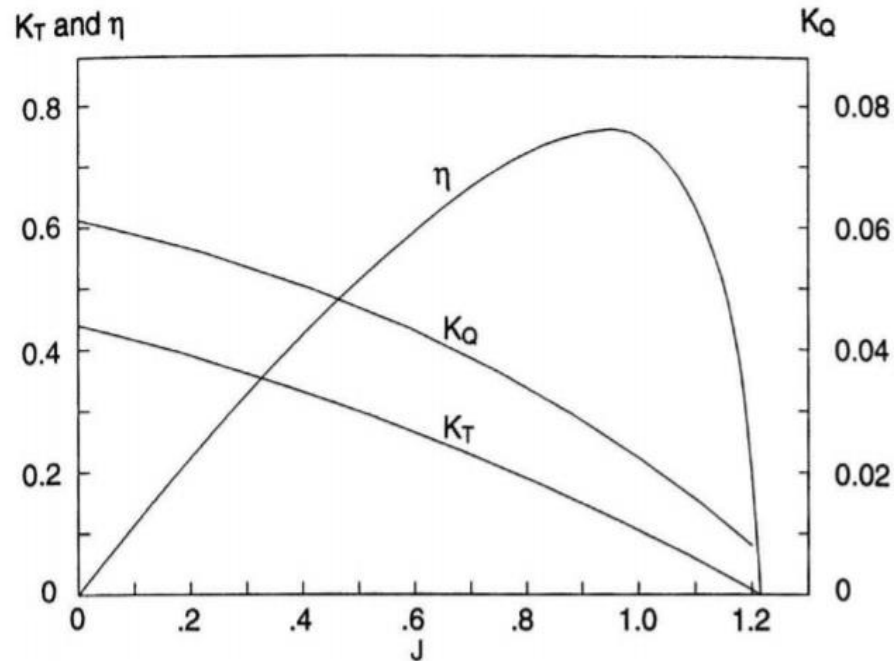
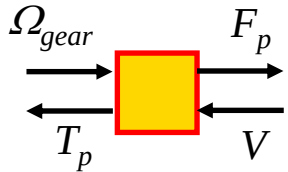
Series Hybrid Engine – Electric Ship



Electric machine + inverter

- Efficiency Map from
 - Experimental data
 - Model-based efficiency map

Series Hybrid Engine – Electric Ship



Propeller Empirical model

- $J = \frac{V_a}{n \cdot D}$
- K_T
- K_Q
- $\eta = \frac{J}{2\pi} \cdot \frac{K_T}{K_Q}$

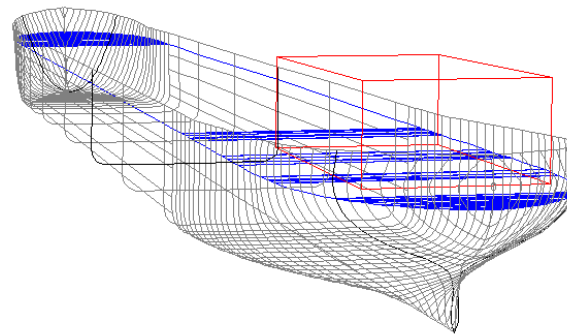
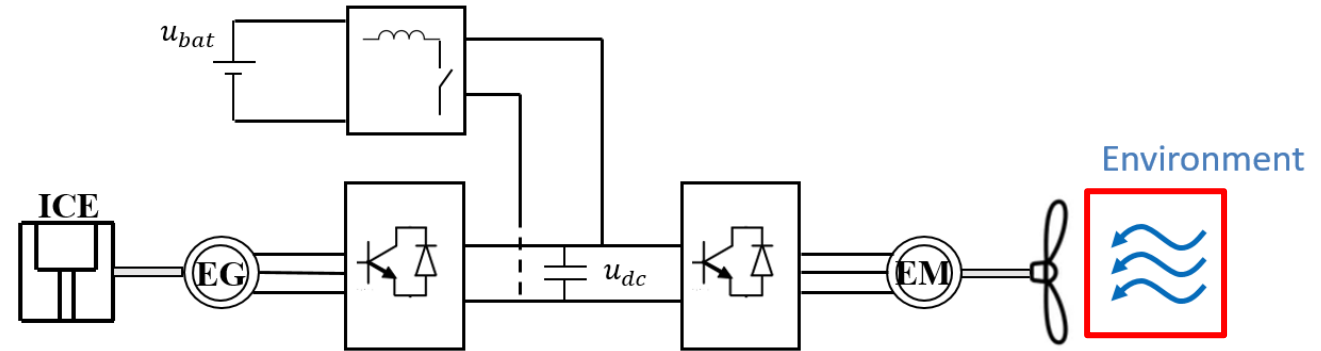
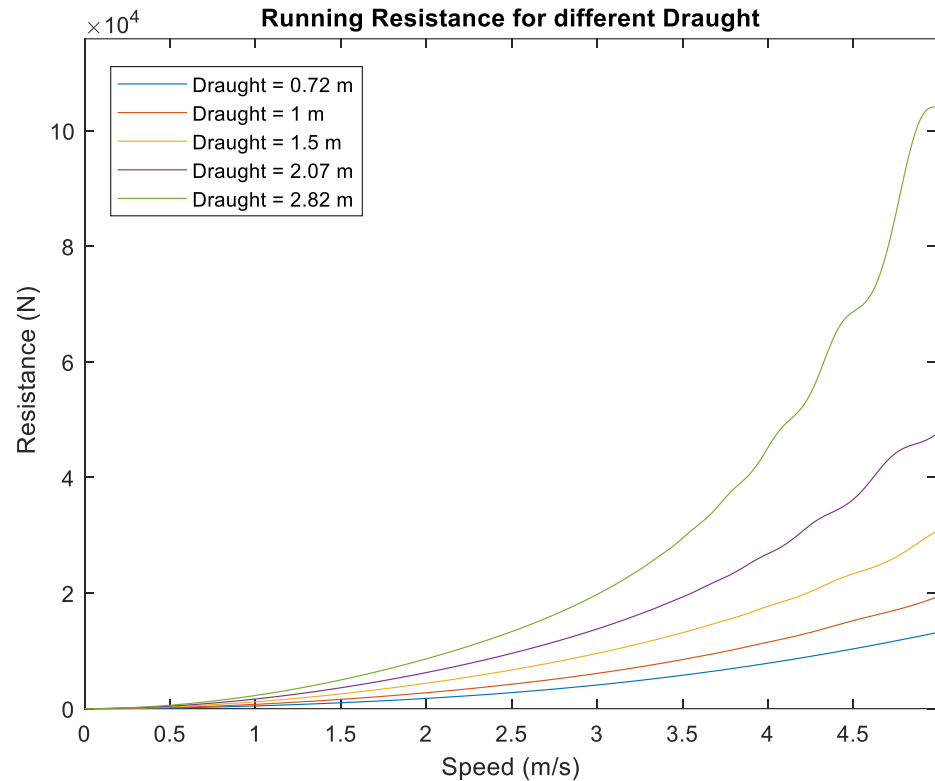
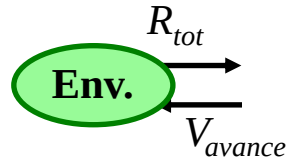
Advance parameter

Thrust coefficient

Torque coefficient

Efficiency

Series Hybrid Engine – Electric Ship

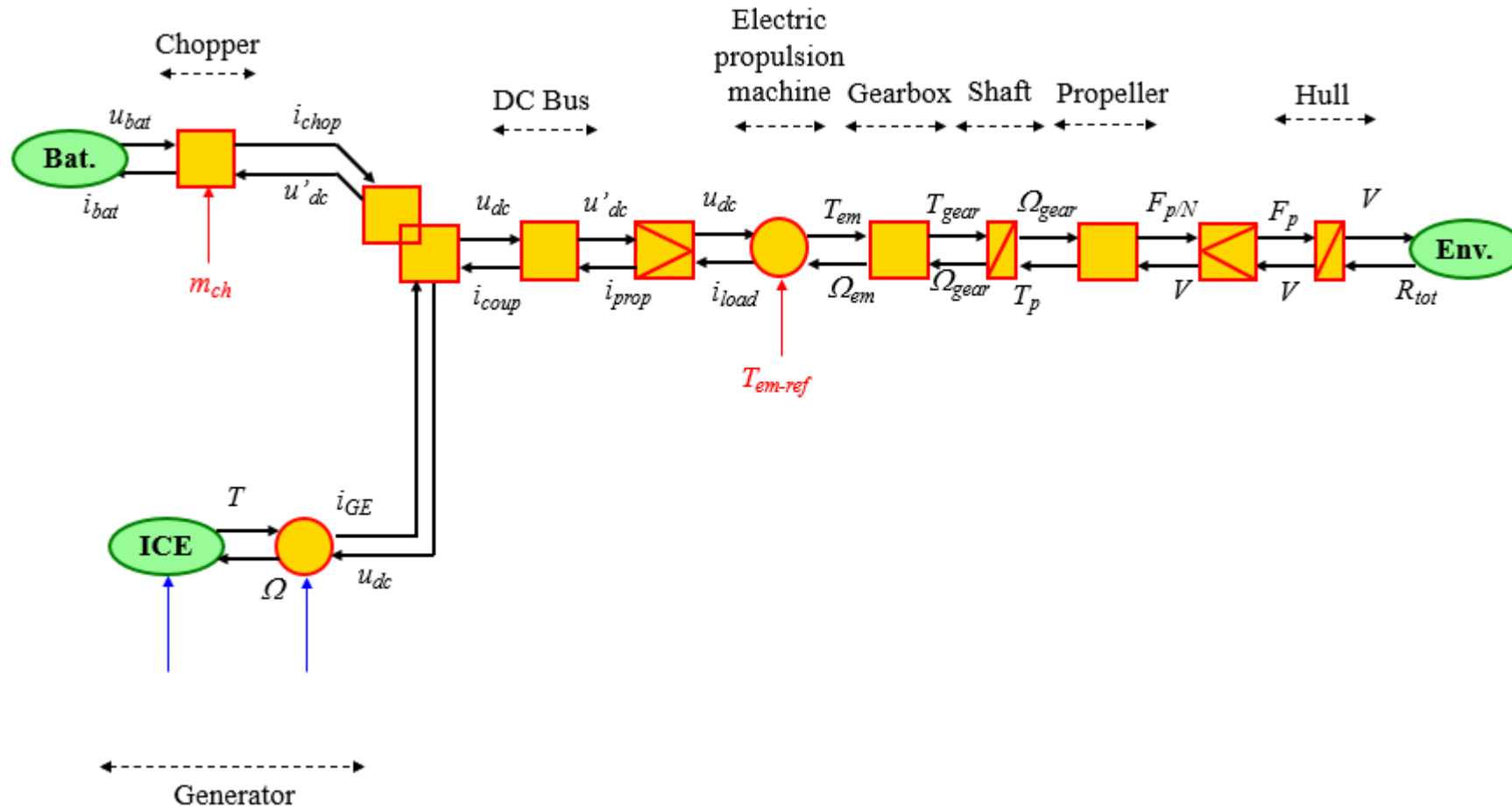


Environment

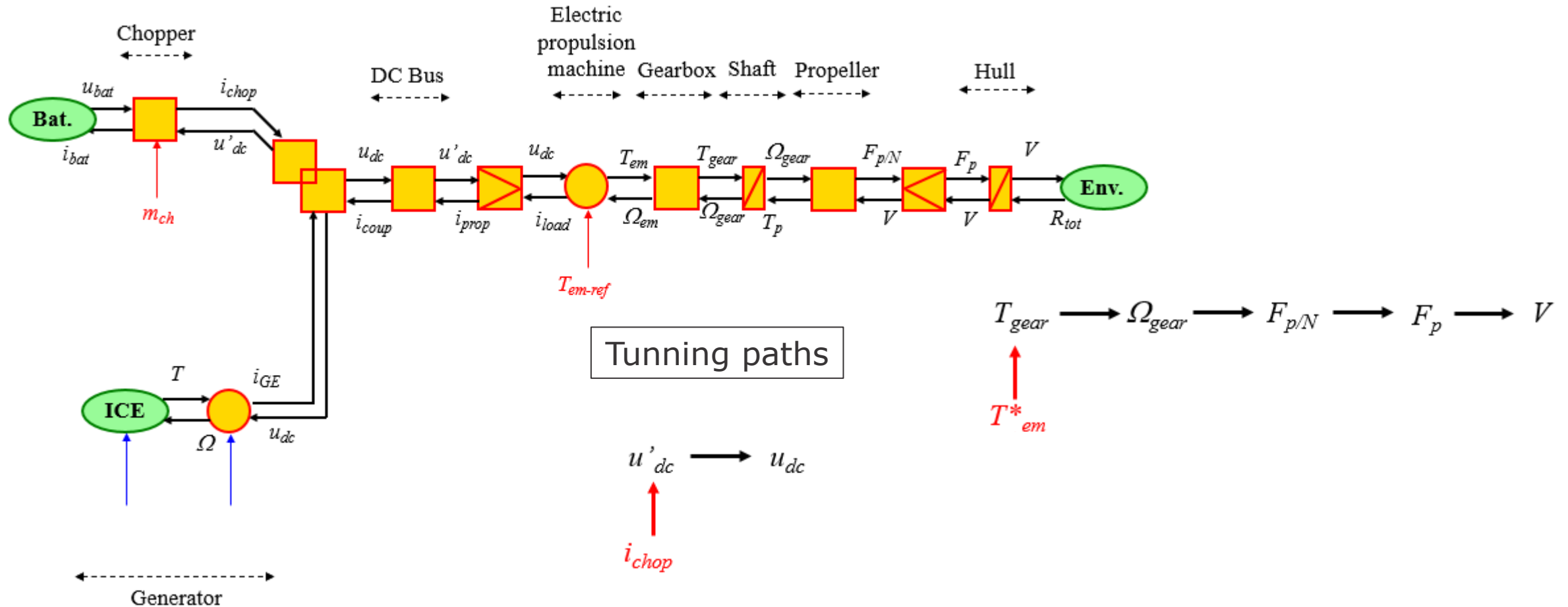
- Unaccurate empirical model
- Typical 10 – 15 % error

EMR of the system

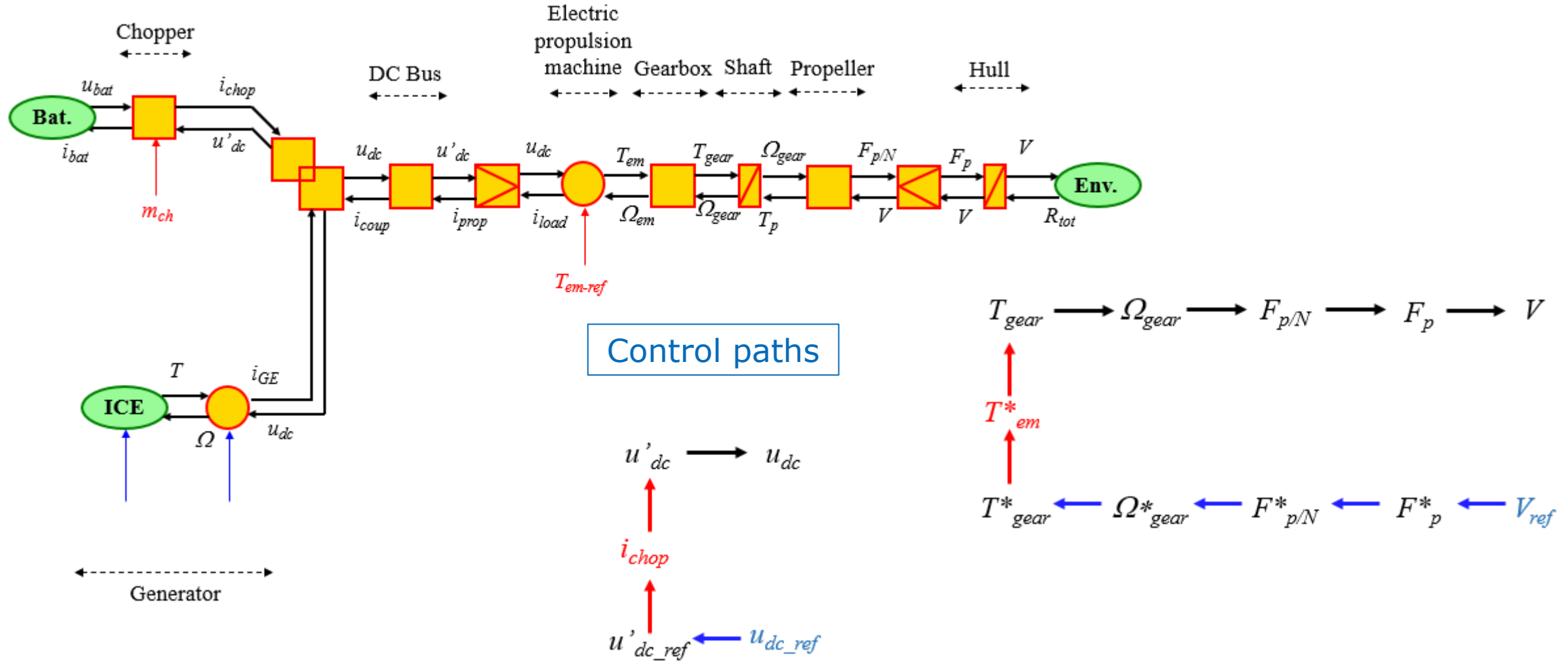
EMR of the system



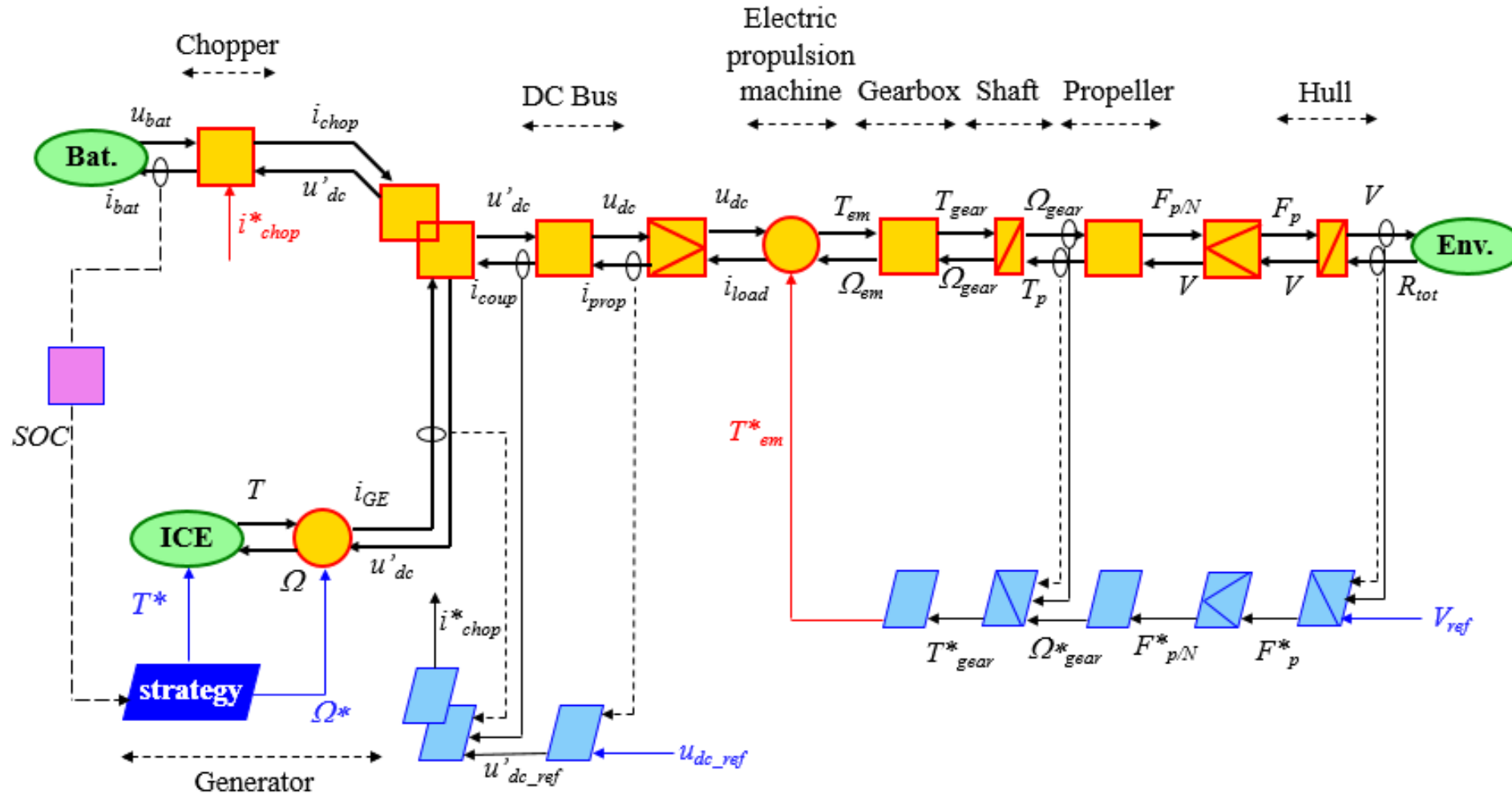
EMR of the system



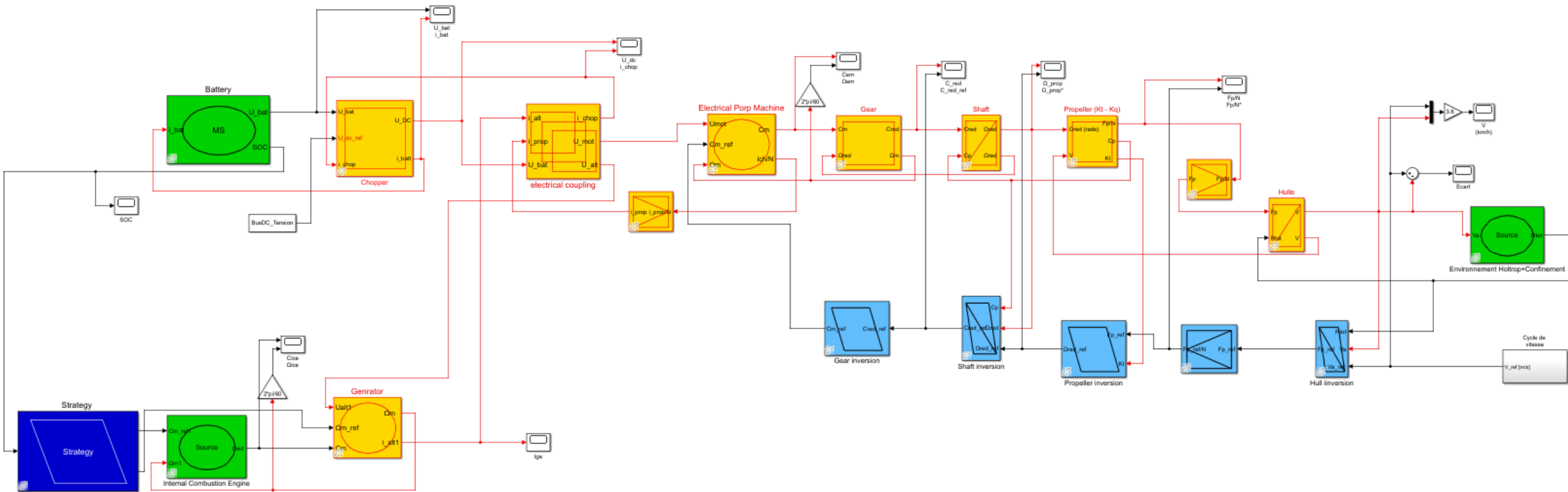
EMR of the system



EMR of the system



Implementation



Results

Results

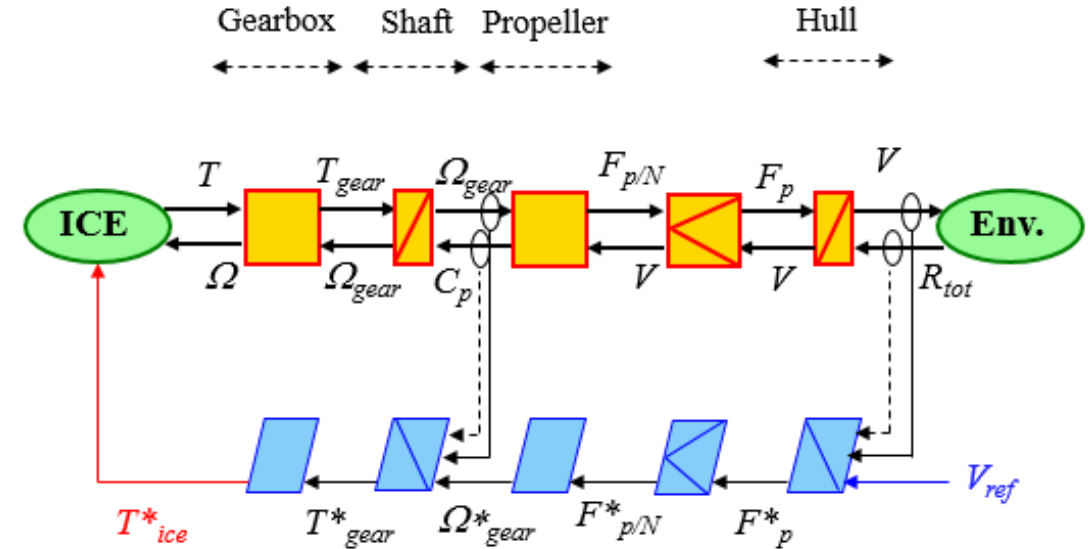


On-board measurement

- Upstream and downstream navigation at fixed engine rotation speed
- Measurements of Rotation Speed ; Power extrapolated from Fuel Injection measurements
- Torque available with post-treatment from Power and Rotation speed

Simulator Input

- Sizing / Parameters of the vessels
- Advance Speed step



Results



On-board measurement

-  Upstream and downstream navigation at fixed engine rotation speed
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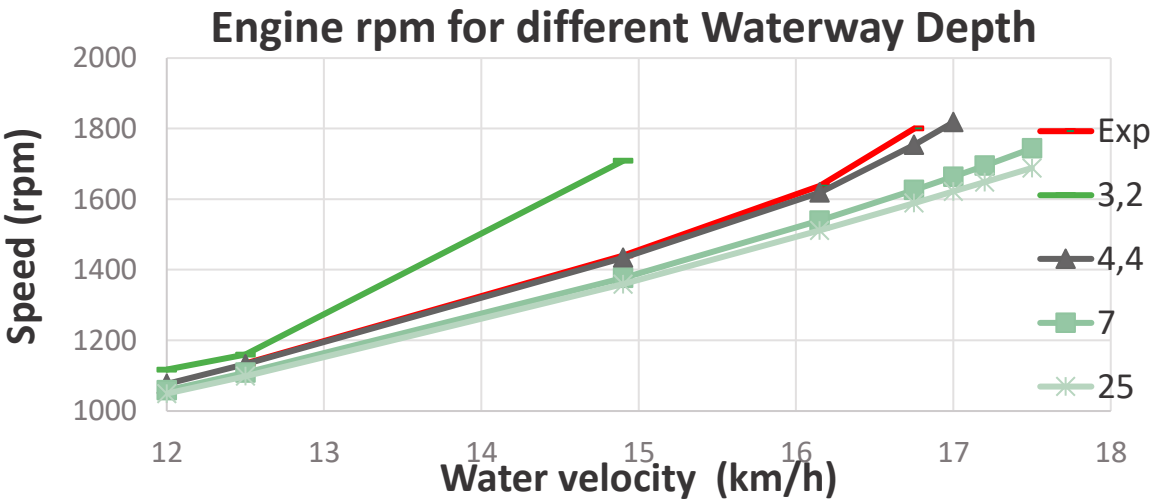
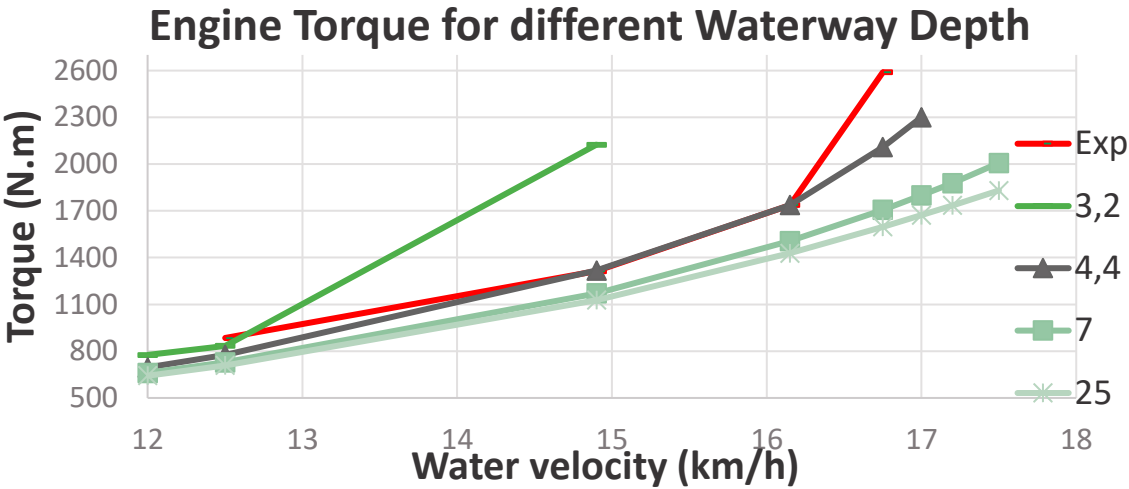
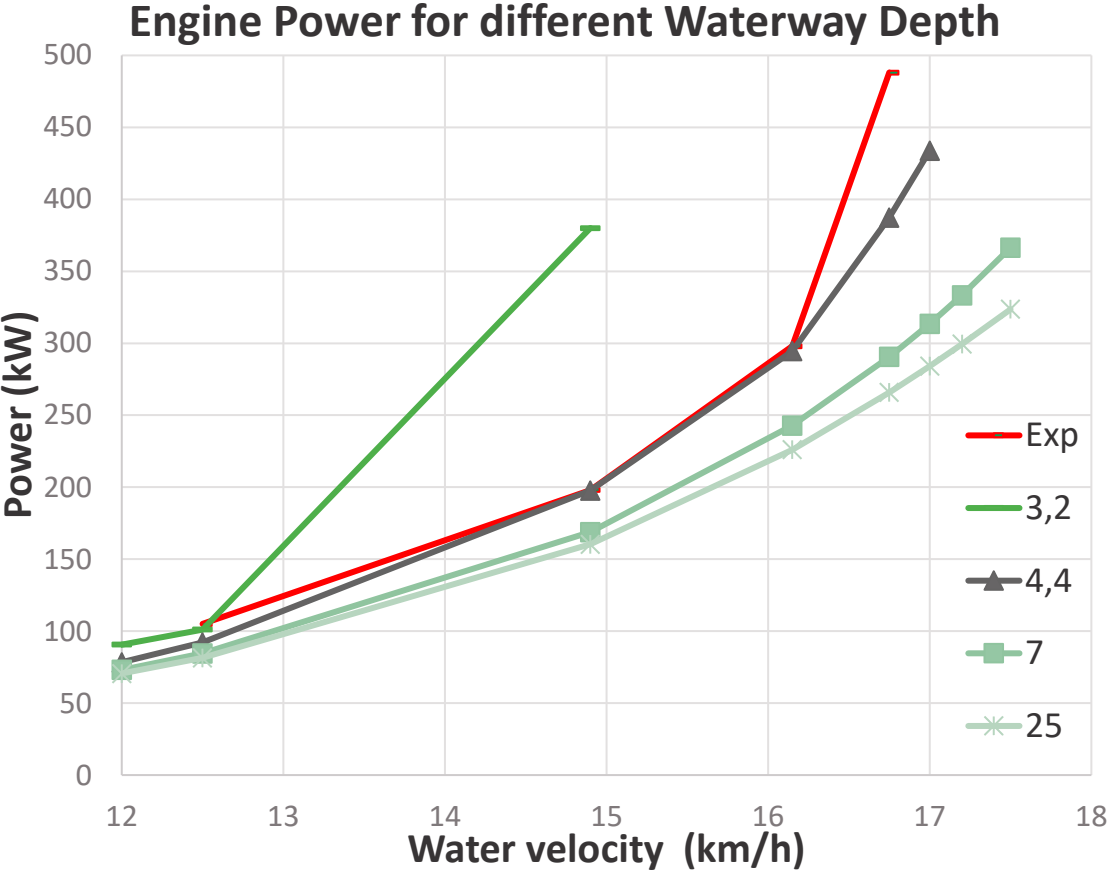
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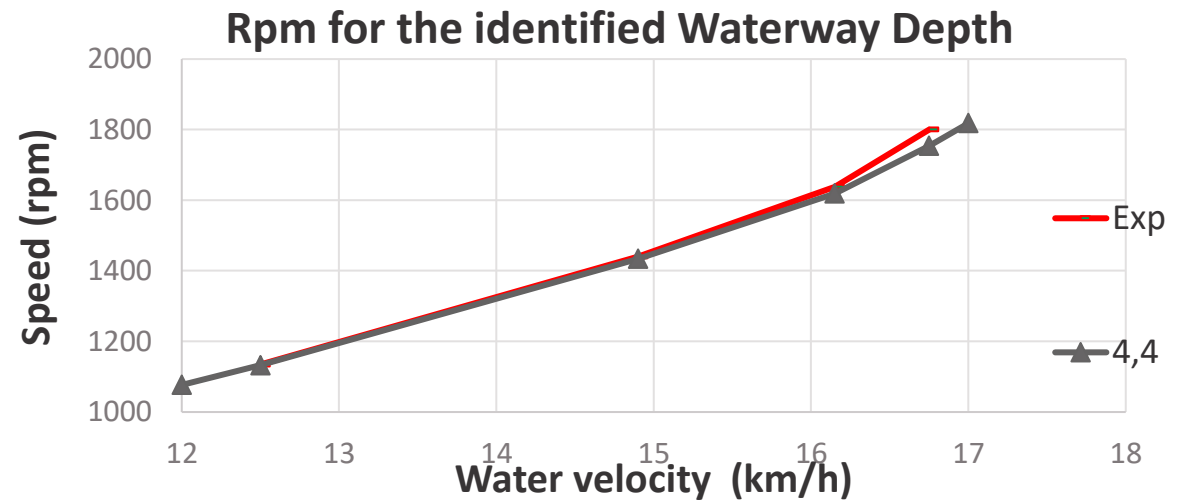
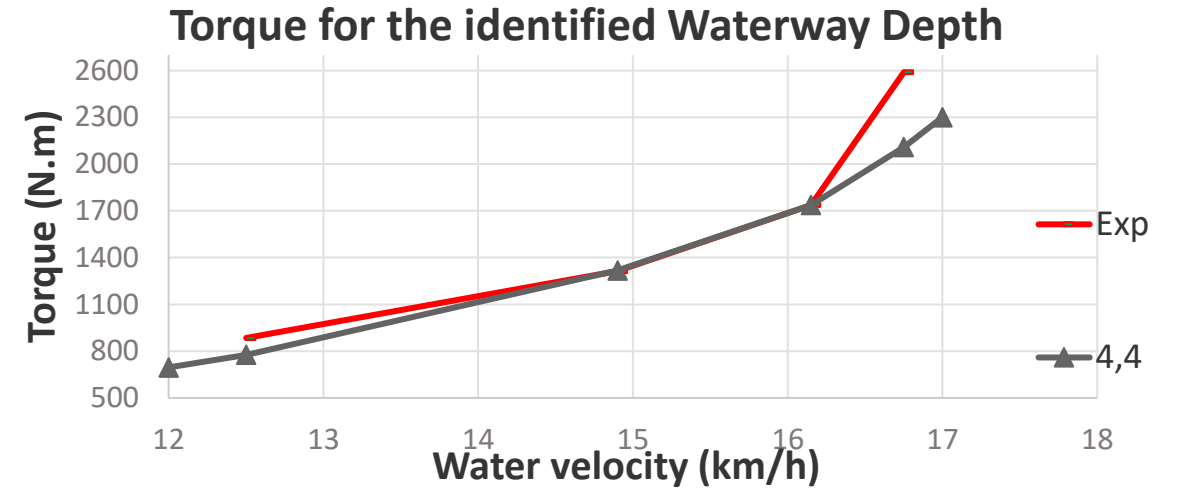
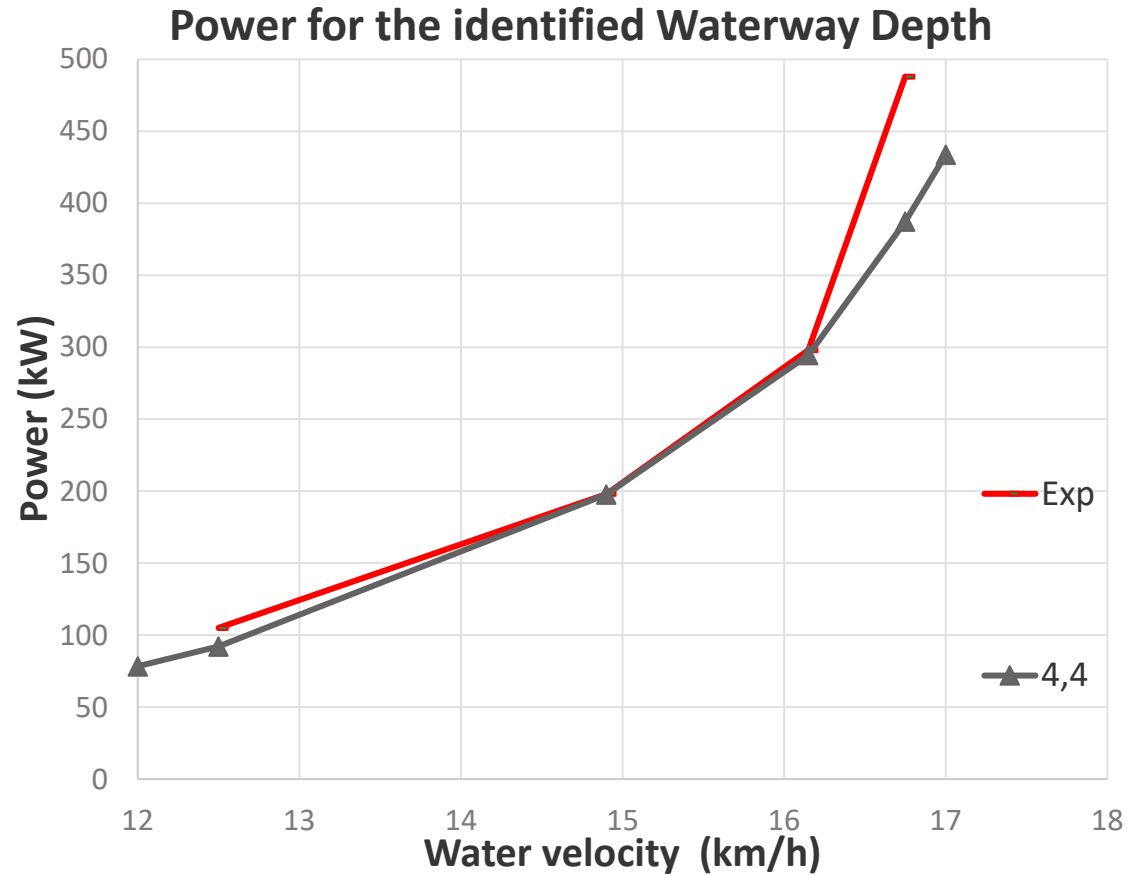


Uncontrolled parameter :
Restricted area of the Waterway

Results



Results



Conclusion

Conclusion



- 🐼 Training with a participation at the EMR summer school 2021
 - 🐼 Tutorial and Examples to implement Hybrid Electric car
- 🐼 Difficulties were more on the control parts of the EMR
 - 🐼 Dynamic to static conversion
 - 🐼 Specific non-linear energy conversion blocks
- 🐼 The PANDA method still makes it easier to simulate multiphysics system
 - 🐼 Libraries and tutorial to deal with many different physics modelling





Evaluation Group



End of presentation

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