Offline real-time high frequency data logging based methodology for PMSM observer design

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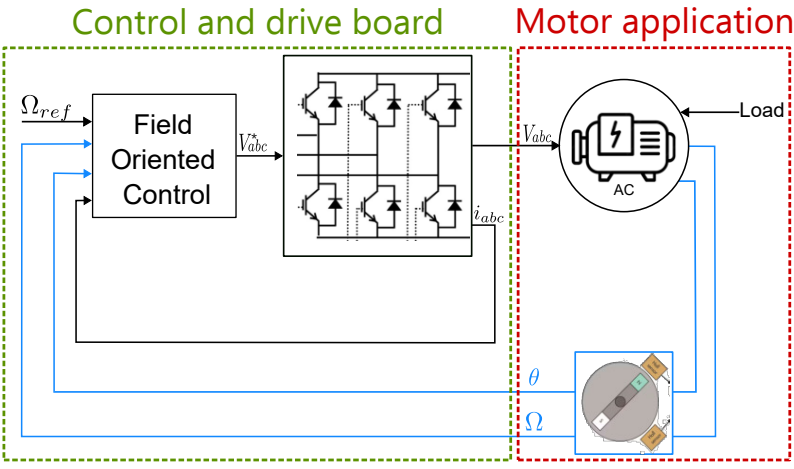
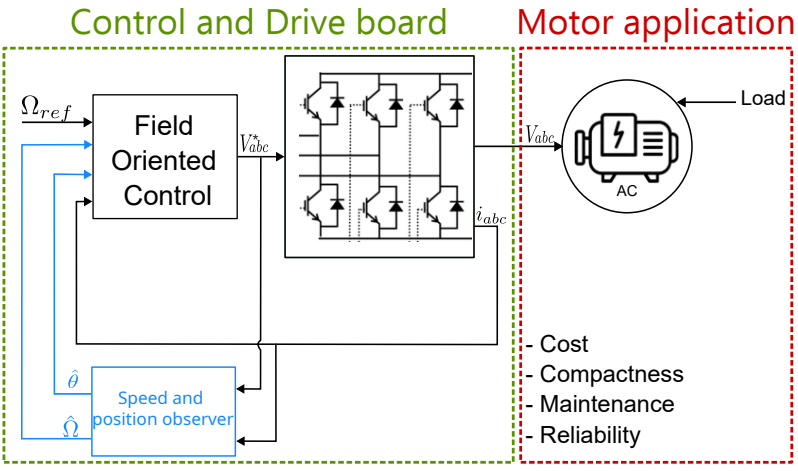
29/05/2024

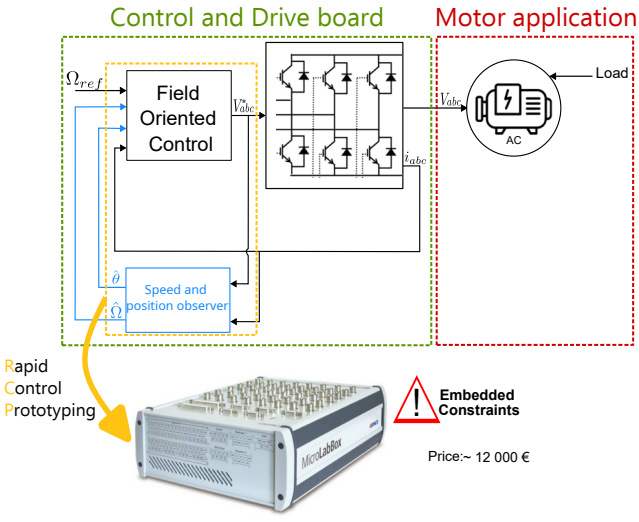
Machine Control



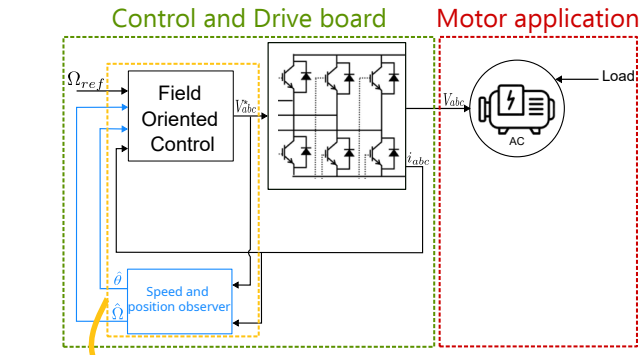
Machine Control



Rapid Control Prototyping



Rapid Control Prototyping



Observer Benchmark

A benchmark for different operating points and performances :

- Low Speed
- Nominal Speed
- High Speed
- Robustness to disturbances

Embedded constraints

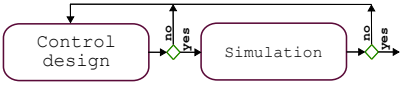
- Parameter uncertainties
- ADC quantification
- Noise measurements
- Delays
- Sensors' precision

...

Classical Approach

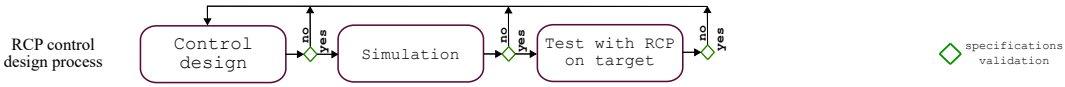
Classical Approach

RCP control design process



specifications validation

Classical Approach



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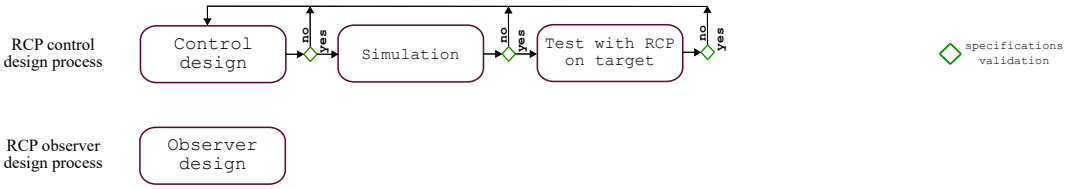

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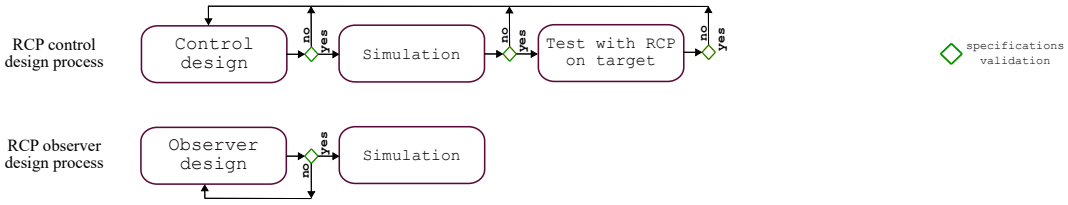

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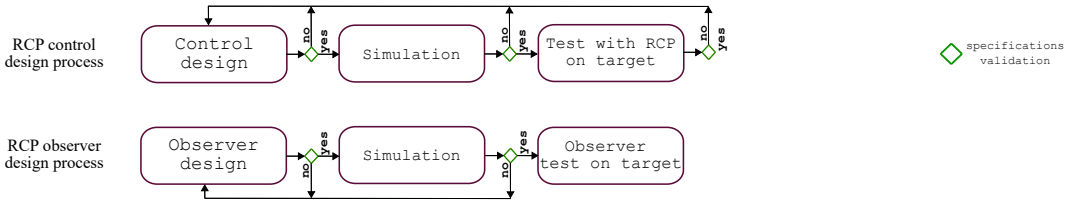

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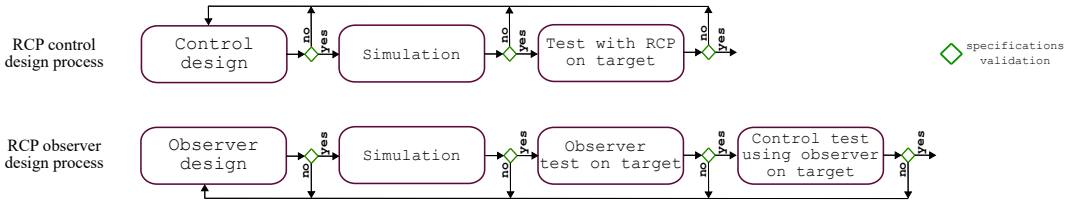

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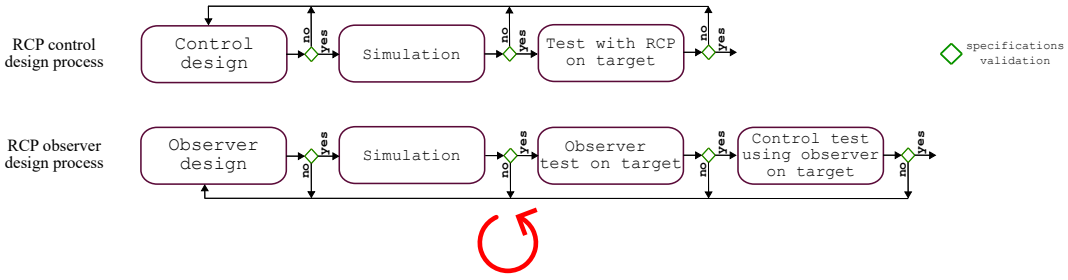
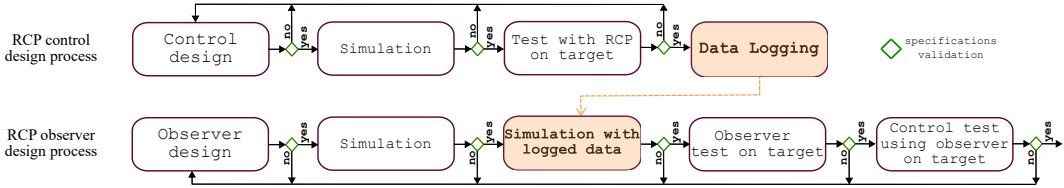


Proposed Approach



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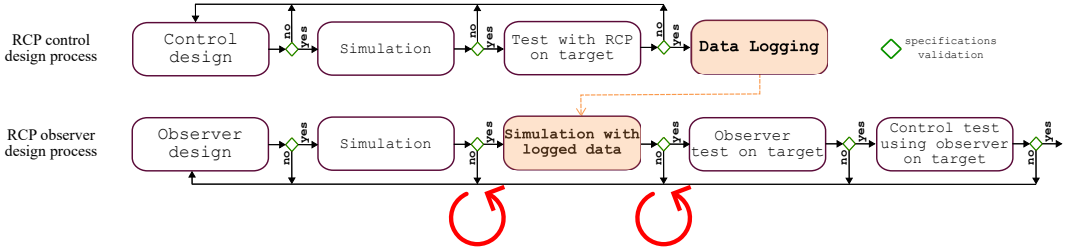
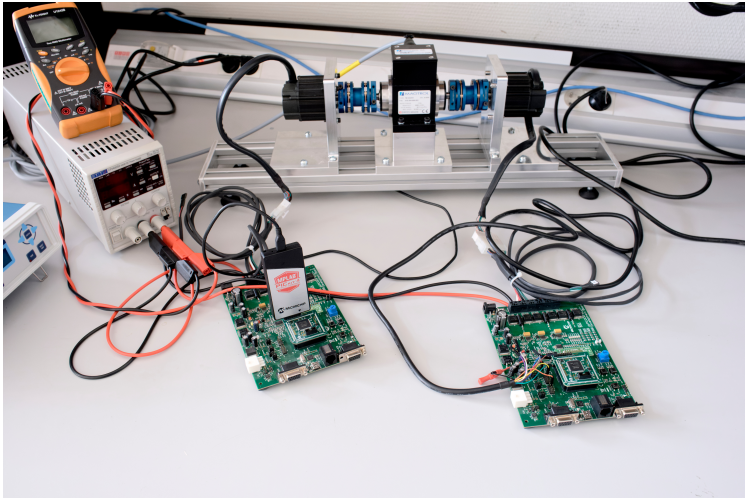


Test bench



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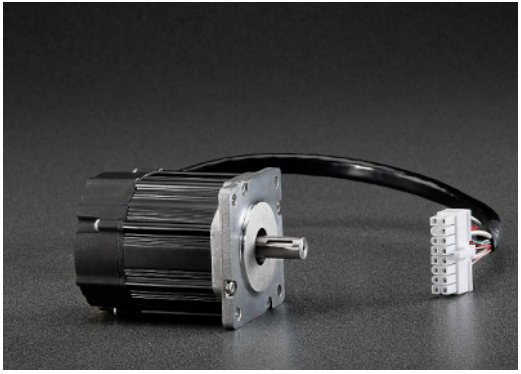
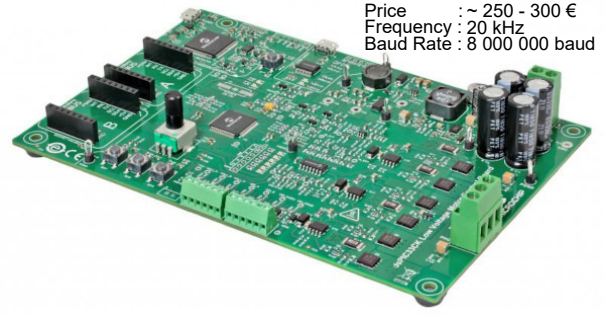
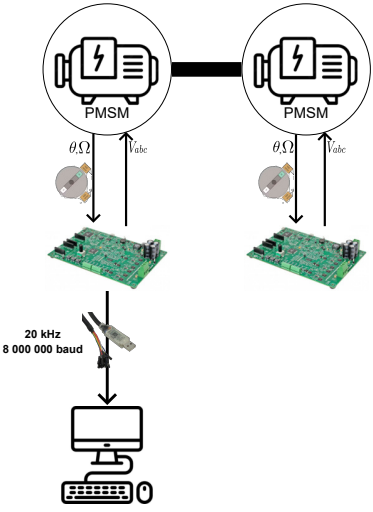


Teknic-2310P motor

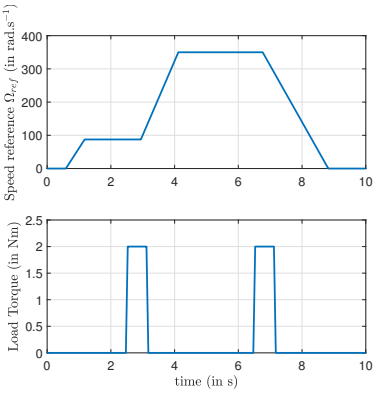


dsPIC33CK LVMC Microchip board

Test bench

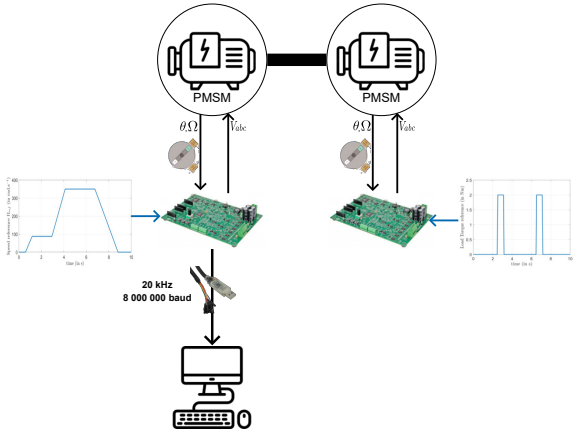

PMSM
PMSM
θ, Ω
V_{abc}
θ, Ω
V_{abc}
20 kHz
8 000 000 baud

Benchmark



. *Sensorless AC Electric Motor Control - Alain Glumineau, Jesús De León Morales - 2015*

Benchmark



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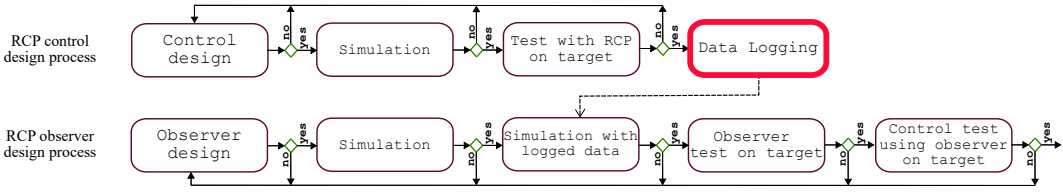
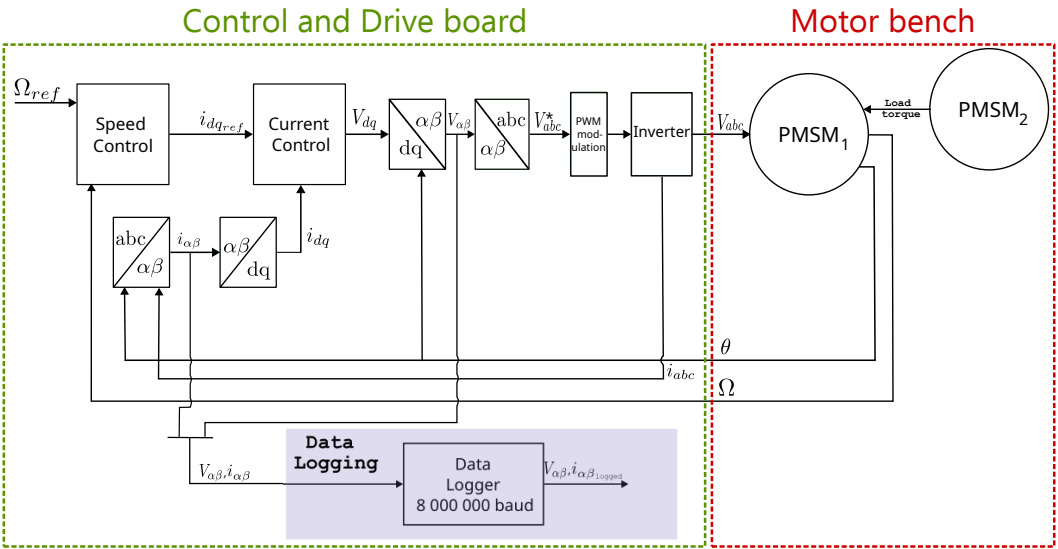
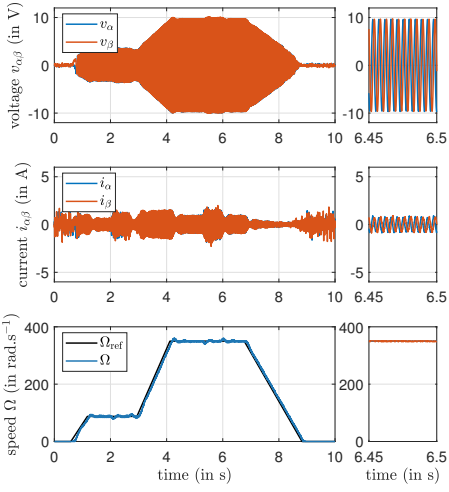
Applied Methodology - Data Logging



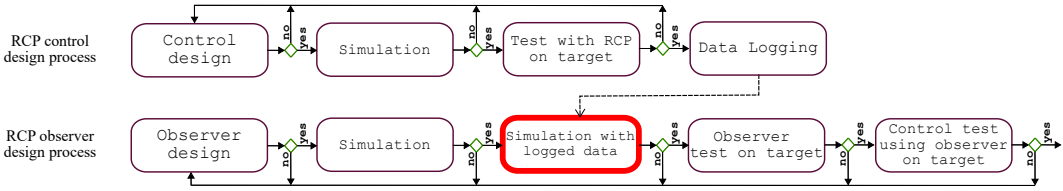
Applied Methodology - Data Logging



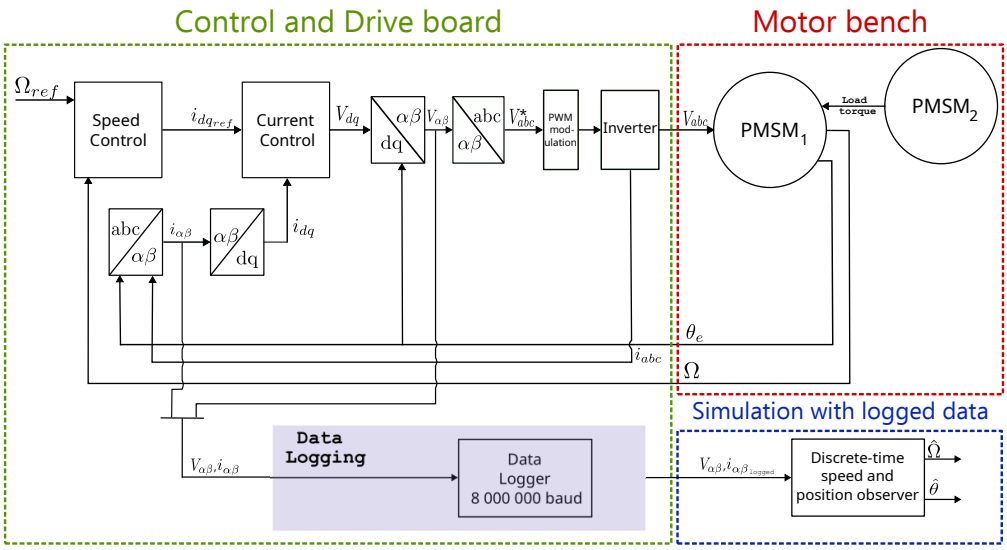
Experimental Data Logging



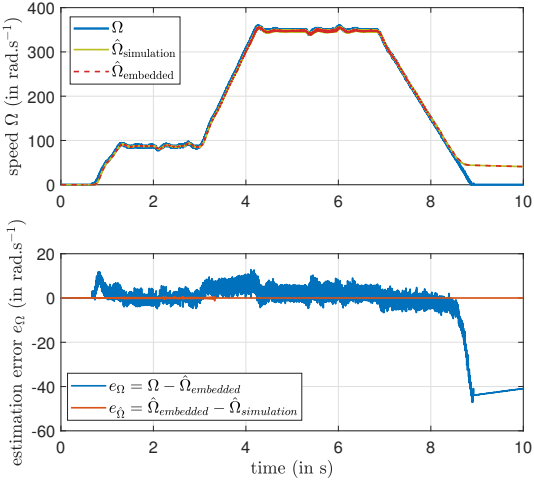
Appplied Methodology - Simulation with Logged Data



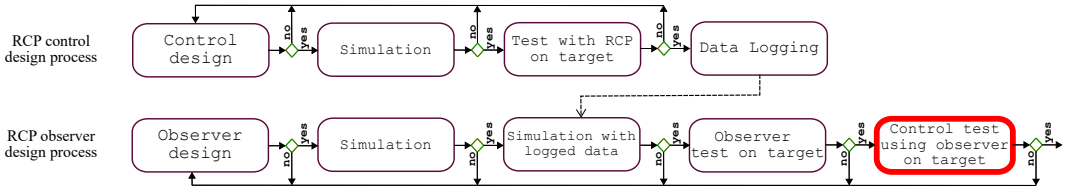
Appplied Methodology - Simulation with Logged Data



Simulation with experimental logged data



Appplied Methodology - Control test using observer on target



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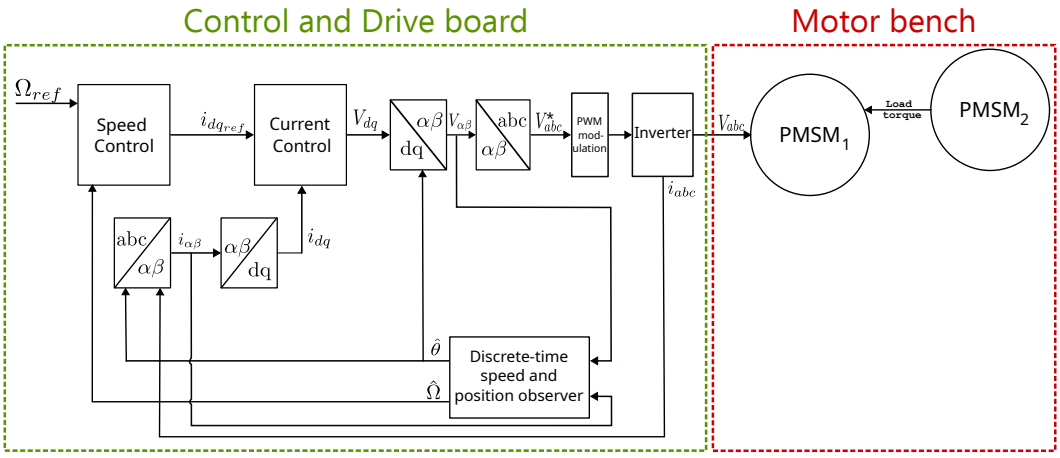
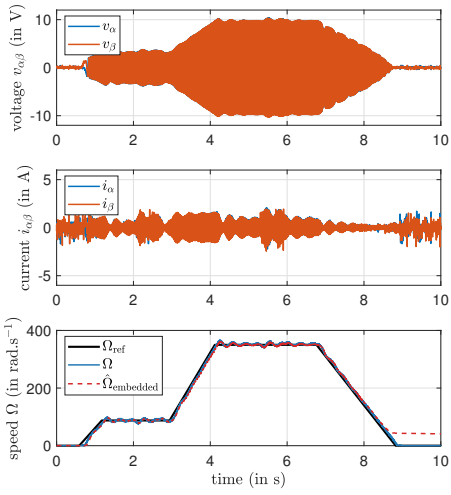


Experimental control using observer



Advantages of the proposed methodology

- Accelerating the open-loop verification : a fixed-step simulation is faster than RCP and on-board test,
- Reducing on-chip gain tuning, since the data used is closer to the embedded behavior,
- Having a unified benchmark for offline comparison between open-loop observers,
- Taking into account implementation constraints for observer open-loop validation, with no hardware.

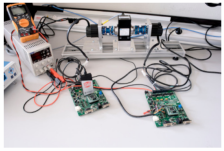
Access to data : ctrl-elec.fr

Research | University | Motor Test Benches | GitHub | YouTube | Contact

- MCU
- Getting Started
- PMSM Modeling
- FOC
- Advanced Control
  - Introduction
  - LMI
  - Observer
- Embedded code
- Lab @INSA

Motor Control University (MCU)

Introduction

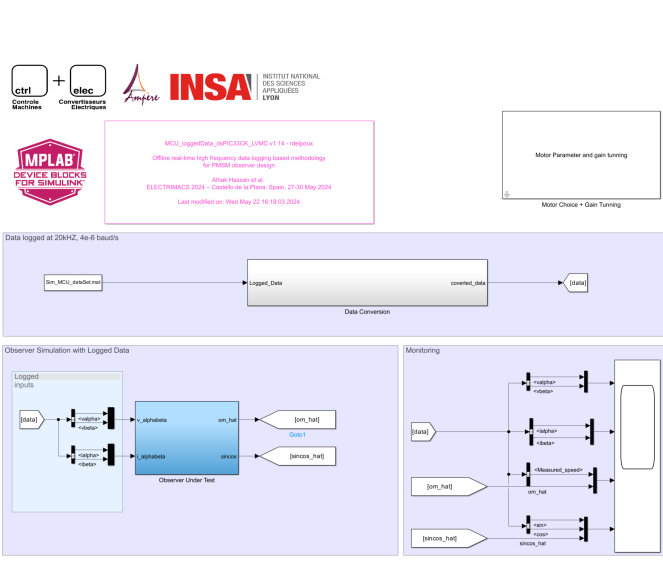


This section is dedicated to tutorials about embedded motor control. The aim of this section is to provide step-by-step guidance for engineers wishing to train and/or specialize in embedded advanced control for electric motor.

YouTube channel

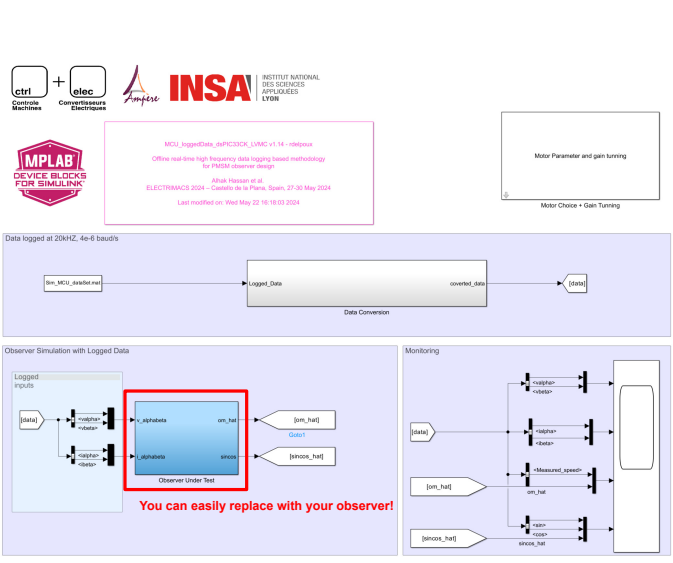
This section is accompanied by a YouTube page

Access to data : ctrl-elec.fr



ctrl-elec.fr/mcu_electric_motor_avanced_control_sensorless.html

Access to data : ctrl-elec.fr



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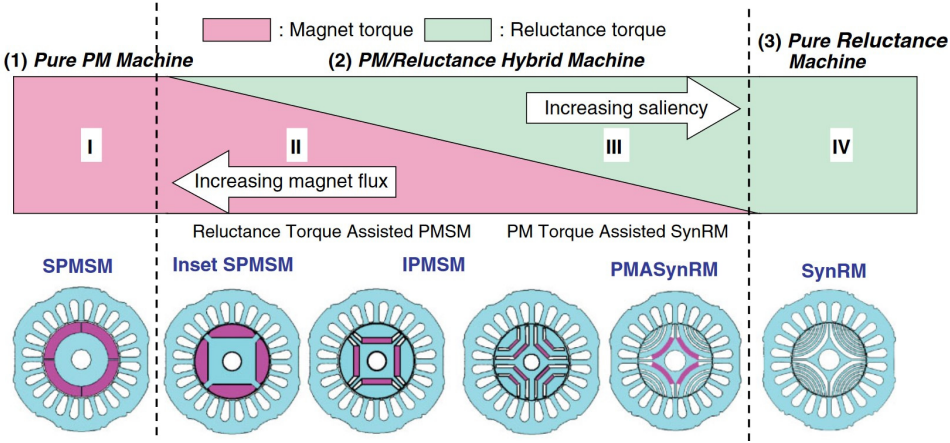
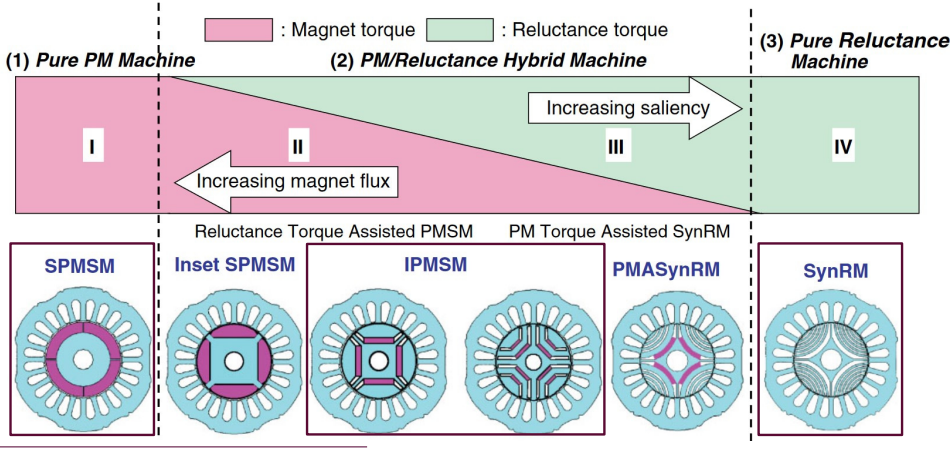
Perspectives



. *Trend of permanent magnet synchronous machines - Morimoto,Shiego - 2007*

Perspectives



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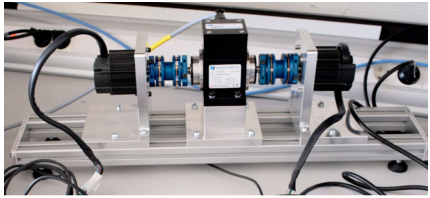
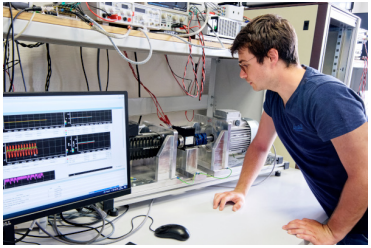
Motor benchs presentation



SPMSM bench

IPMSM bench



SynRM bench

Thank you for your attention