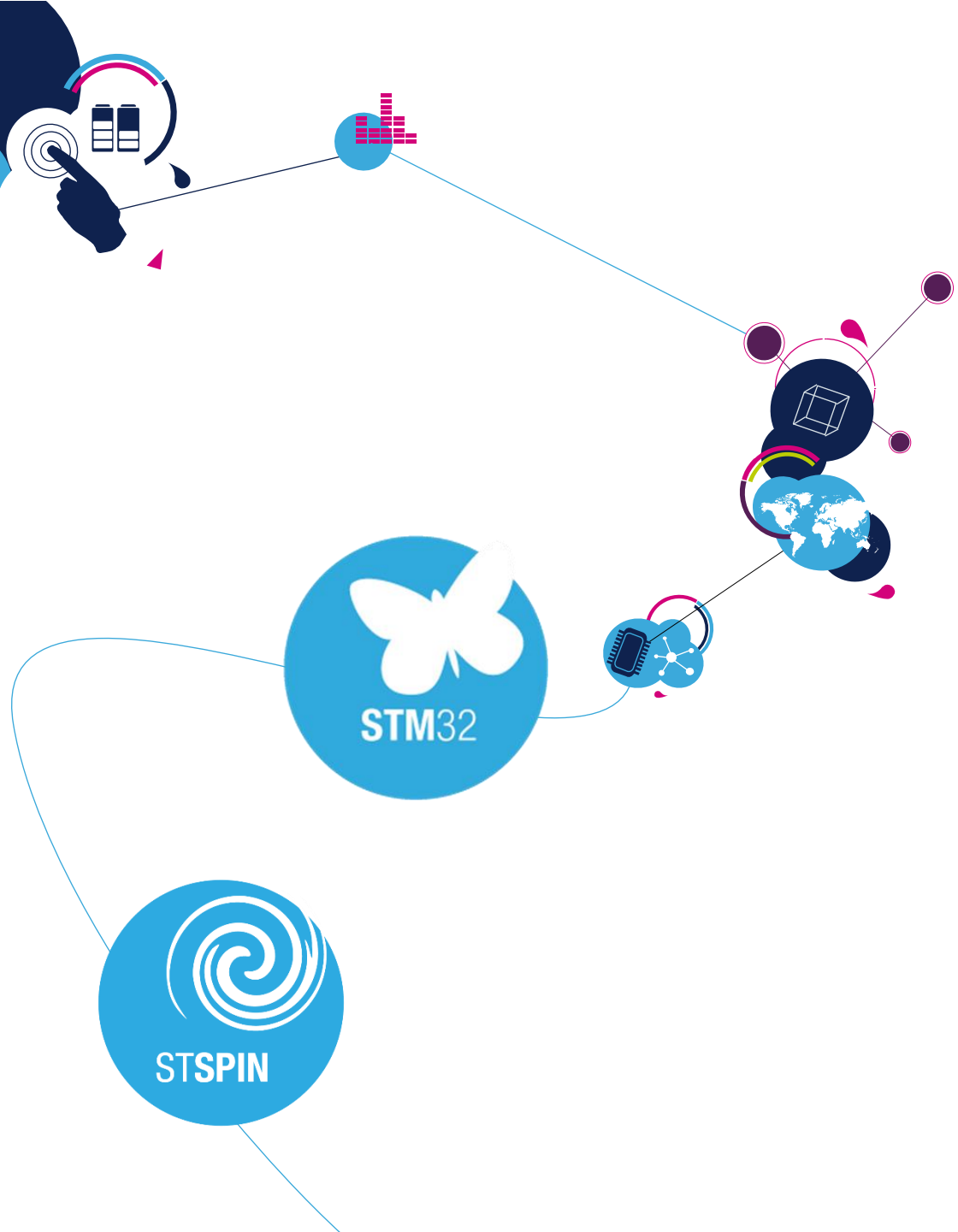
ST Motor Profiler

Motor Profiler
Motion Control Suite



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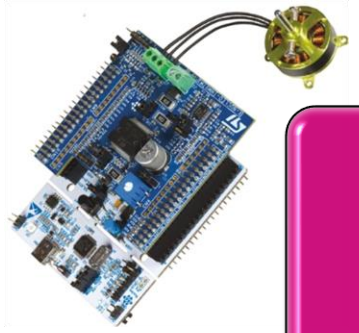
Motor Control Development Workflow

#2 – Motor Characterization



Hardware Setup

Motor Characterization

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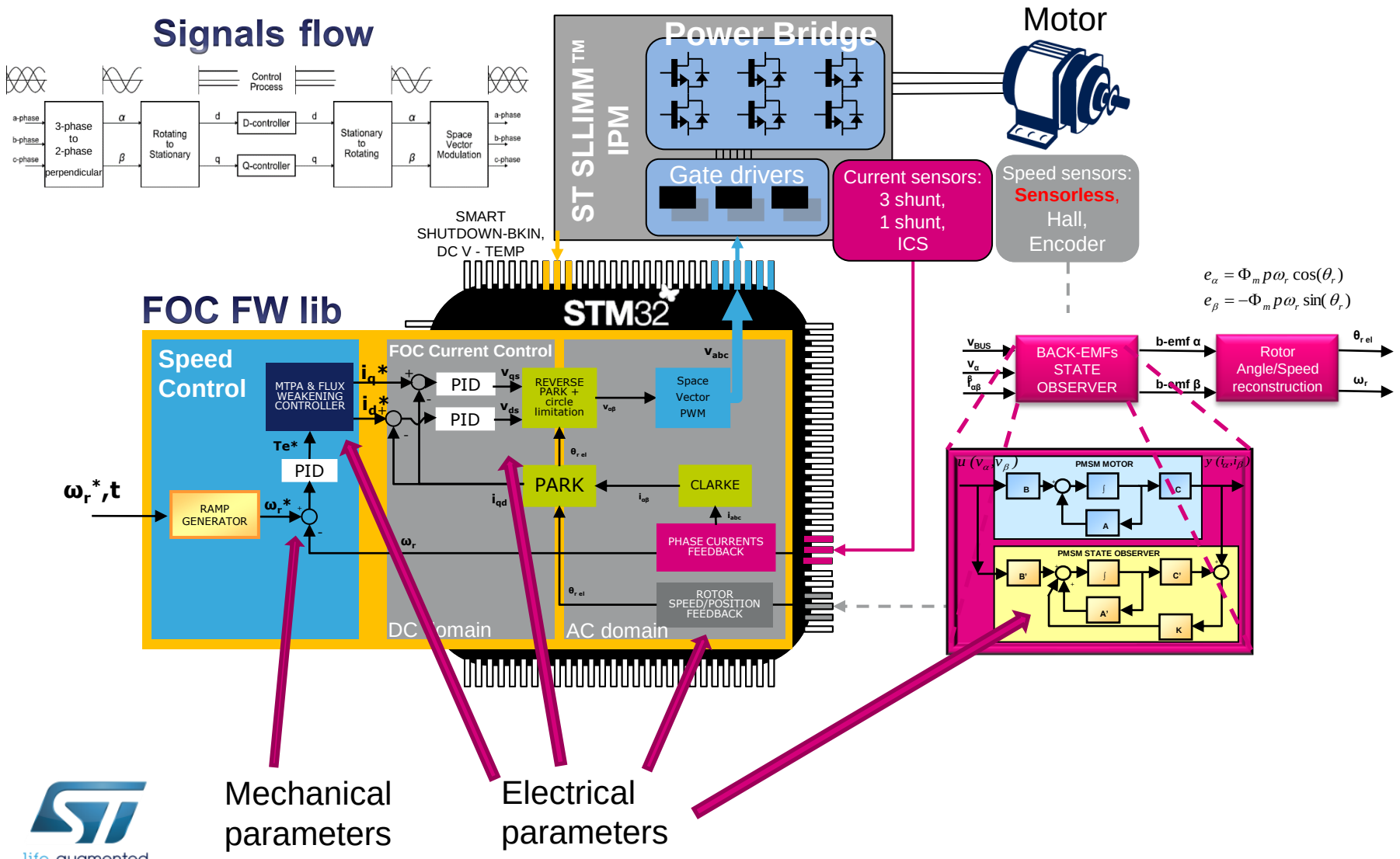
LAB 2 tasks

- What is ST Motor Profiler?
- Automating Characterization of Three Phase BLDC Motor with the ST Motor Profiler

- Tip and Tricks how to work with the ST Motor Profiler

What is necessary for MC application?



$$e_\alpha = \Phi_m p \omega_r \cos(\theta_r)$$
$$e_\beta = -\Phi_m p \omega_r \sin(\theta_r)$$

- The algorithms require electrical and mechanical parameters to define the used model of the motor
- To tune the current regulators
- To tune the speed regulator
- For Sensorless state observer algorithm
- For additional features

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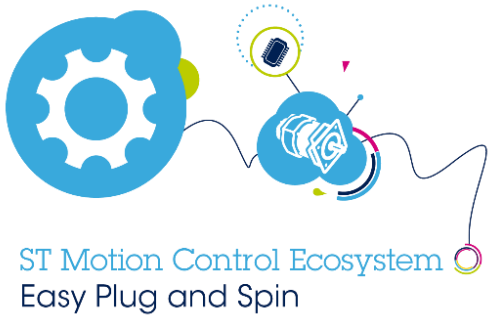
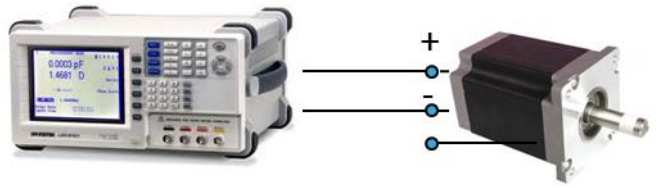
Motor Profiler



- Plug & Spin your Motors in only few minutes
  - With STM32 Motor Control Software Development Kit (MCSDK)
  - With ST Control and Power Boards

Manual measurement or “Motor Profiler”?

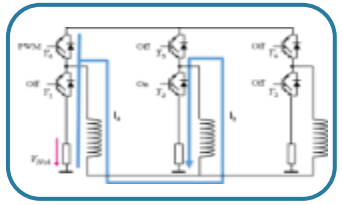
- **You can measure / observe the motor parameters manually**
  - You can find more information in MOOC “Measurements of Motor Parameters” on udemy.com
- **Sometimes it can be hard to start the evaluation of motor control solution**
  - Measuring of the motor parameters can require specific skills and equipment
  - Tuning of the regulators can be empirical
  - Finding the proper acceleration for the startup is not easy
  - Many trials and errors can occur before 1st run of the motor



ST Motor Profiler

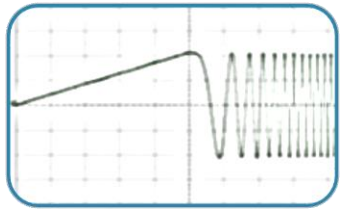
- Very easy and fast procedure
  - ST Motor Profiler has specific adaptive algorithms (repetitive) to find the best result
  - Motor can spin in less than one minutes in the best case

Motor stopped
- R_s measurement
- L_s measurement
- Current regulators set-up



10 sec

Open loop
- Ke measurement - B_{EMF} constant
- Sensorless state observer set-up
- Switch over



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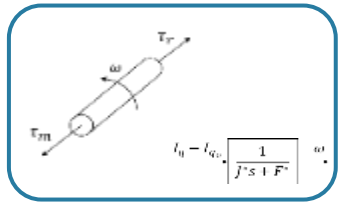
Closed loop
- Friction coefficient measurement
- Moment of inertia measurement
- Speed regulator set-up



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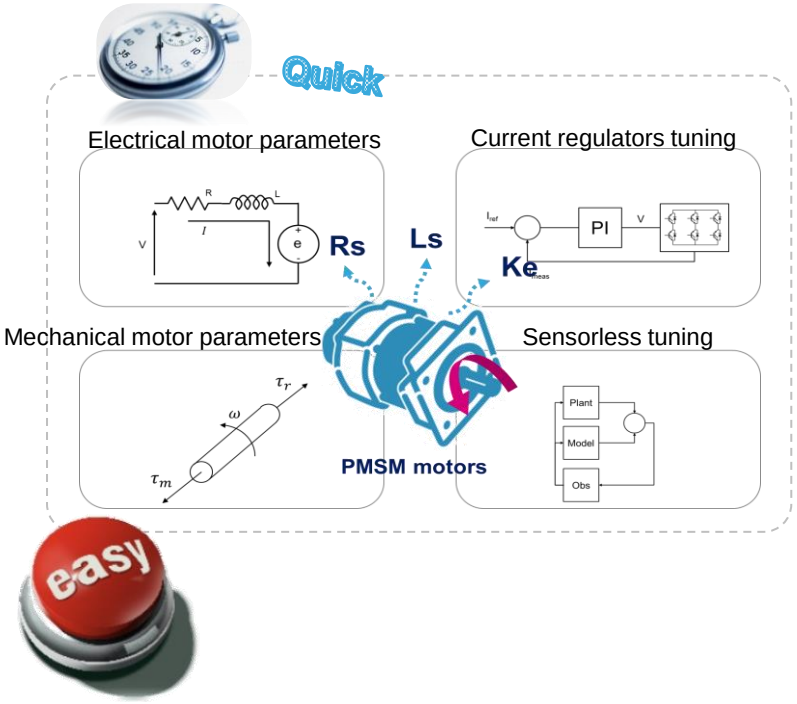

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Motor Profiler - What can't be measured?

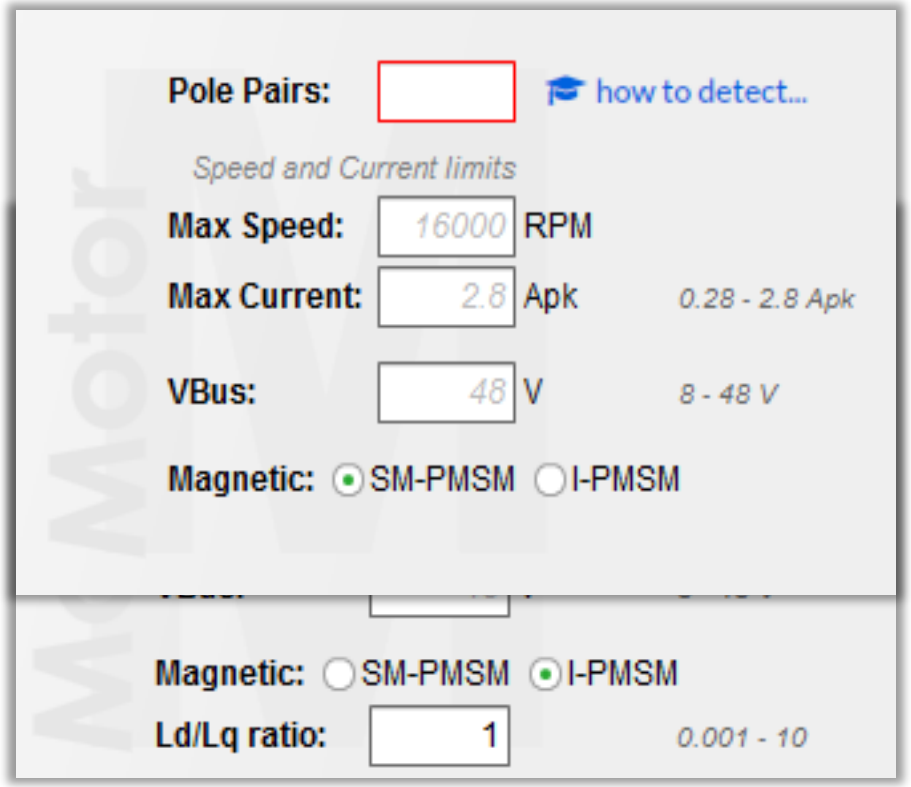
User must know or measure manually:

(It requires additional tools)

- **Motor pole pairs** (mandatory)
- Maximum application speed
- Maximum current
- Vbus voltage
- (Motor anisotropy Lq/Ld ratio)

SM-PMSM

I-PMSM



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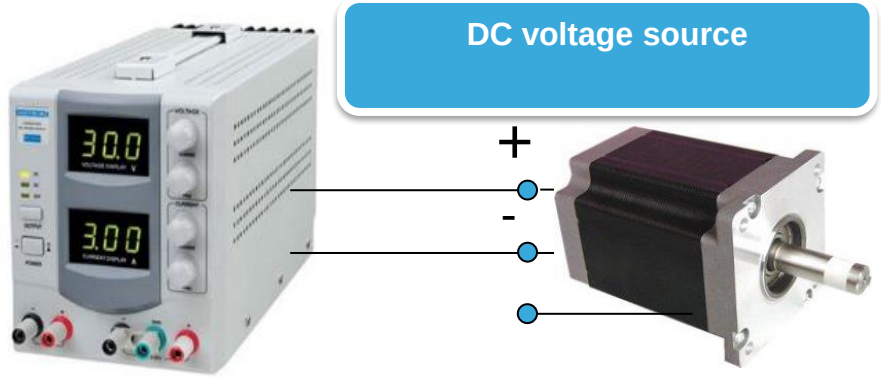
BLDC motor – Pole pairs number

- Usually, it's provided by motor supplier, but …

- In case it is not or if you would like to double check it
  - You can connect a DC power supply between two motor phases with a limited current
  - Check the rotor and try to find stable position
  - You can increase the current up to nominal one in case you are not able to find a stable position
  - The number of rotor stable positions in one mechanical turn represents the number of pole pairs

- Or ...

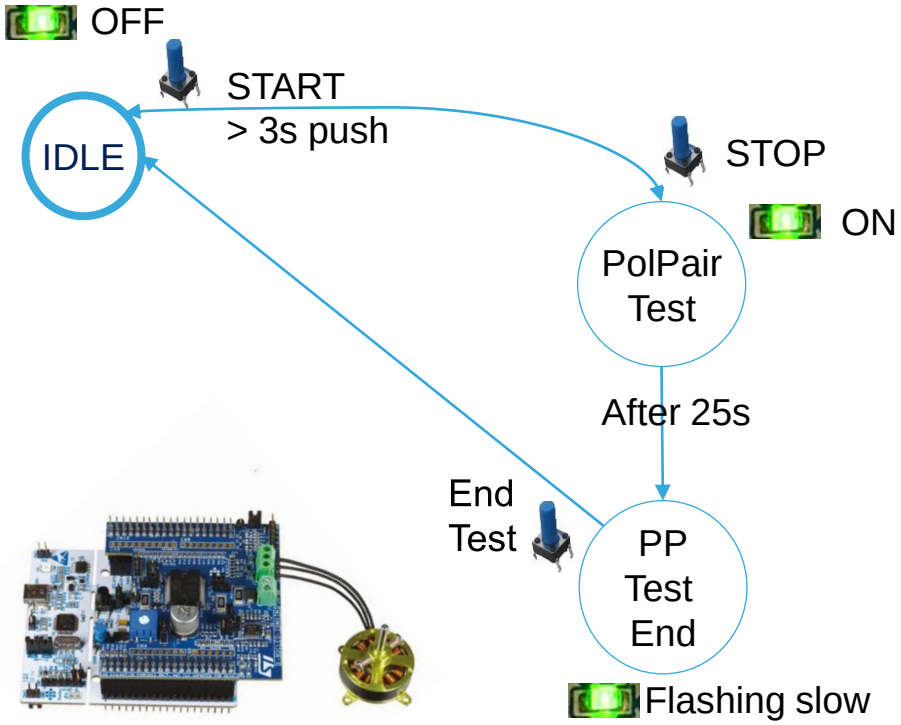


BLCD motor – Pole pairs number (FW)

- We have prepared for you a special test FW
- You can use the provided HW setup (Nucleo F303RE & IHM16 boards)
- Including already loaded test FW
- Now you only need to start the test FW for pole pairs measurement
  - Press blue button for 3 seconds
  - Rotate the rotor by hands (you should notice some resistance)
  - The number of rotor stable positions in one mechanical turn represents the number of pole pairs (PP)

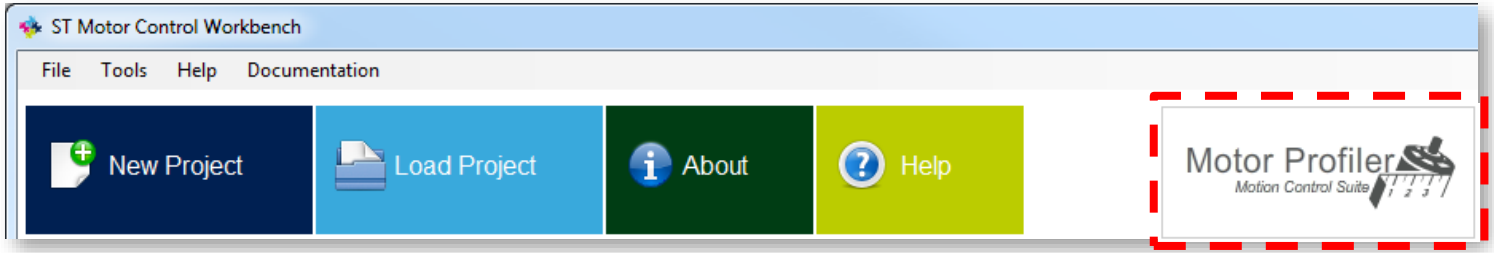
Remember the number of PP or write it down!

Testing MC firmware



Open the Motor Profiler

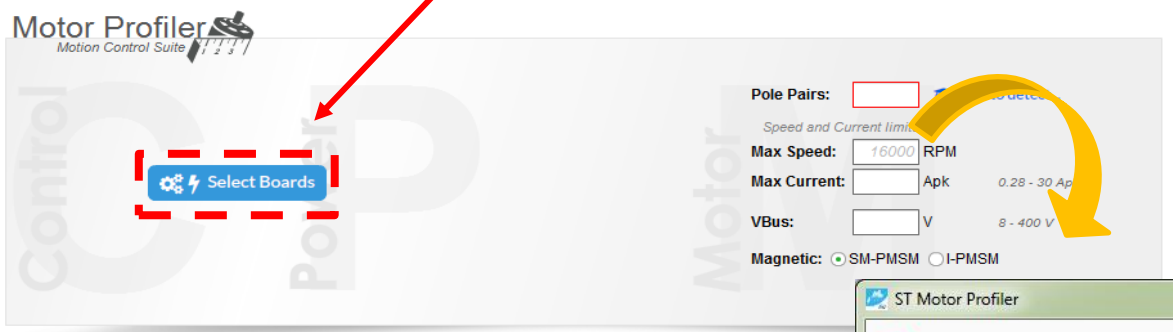
- Open the Motor Profiler
  - Directly by desktop icon
  - or with item in Windows Start menu
  - or by the dedicated button in the MC Workbench



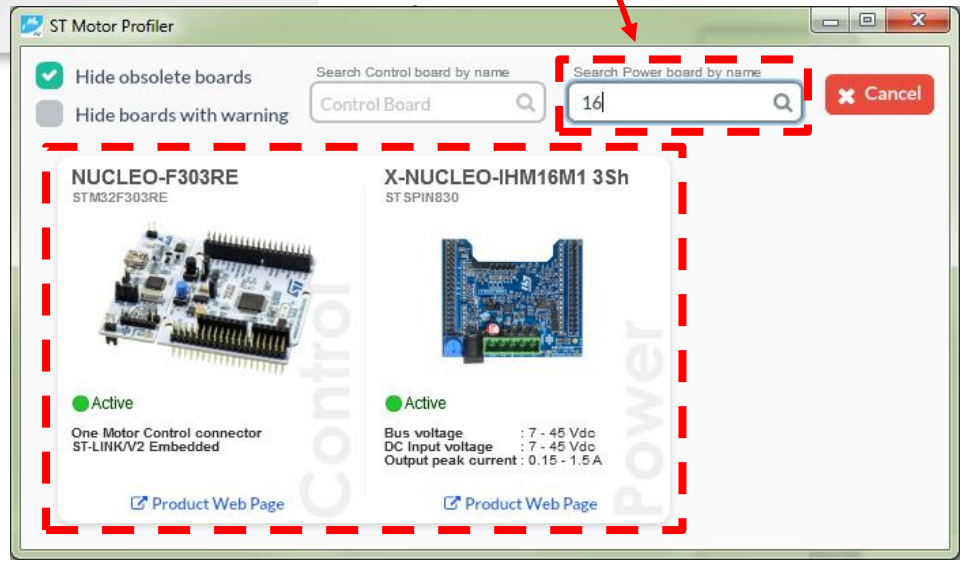
Hands-On section

Select the HW boards

- Click on button “Select Boards” to display the list of supported boards
  - The Motor Profiler feature can be used only with the listed systems



- Selection of the **NUCLEO-F303RE** and **X-NUCLEO-IHM16 3Sh**
  - Use the search filter for Power Board
    - Type number 16



- Click on the Nucleo F303 + IHM16 boards picture

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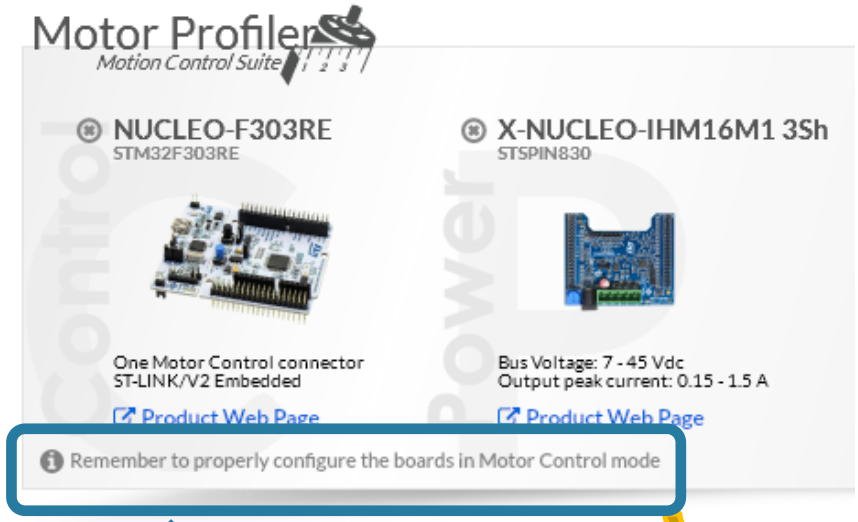
Hands-On section

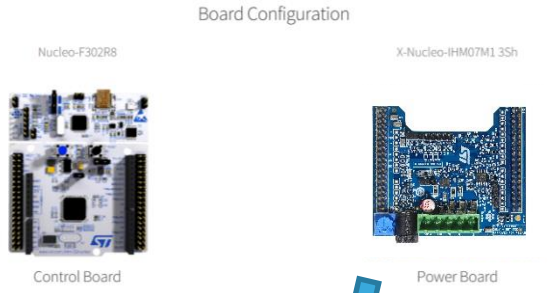
Why do we use 3-shunt setup?

- It is recommended to use the 3-shunt topology
  - to achieve better current measurement
  - consequentially better performance of Motor Profiler Algorithm.
- This is especially true for low-inductance motors
  - like dron motors and high speed motors.

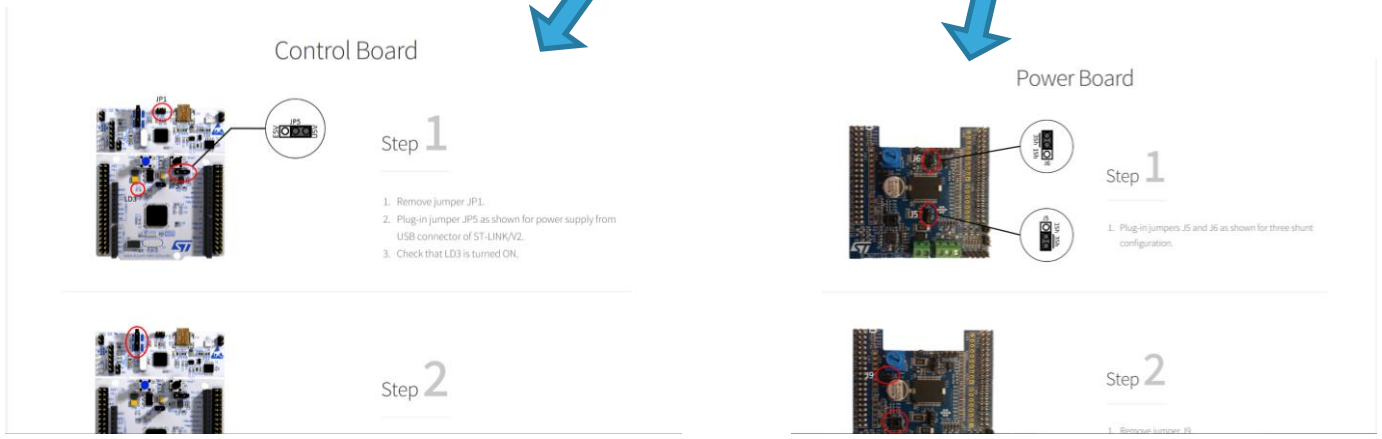
Hands-On section

How to check the board Jumpers link inside the Motor Profiler





Open Board configuration window by clicking on this text/link



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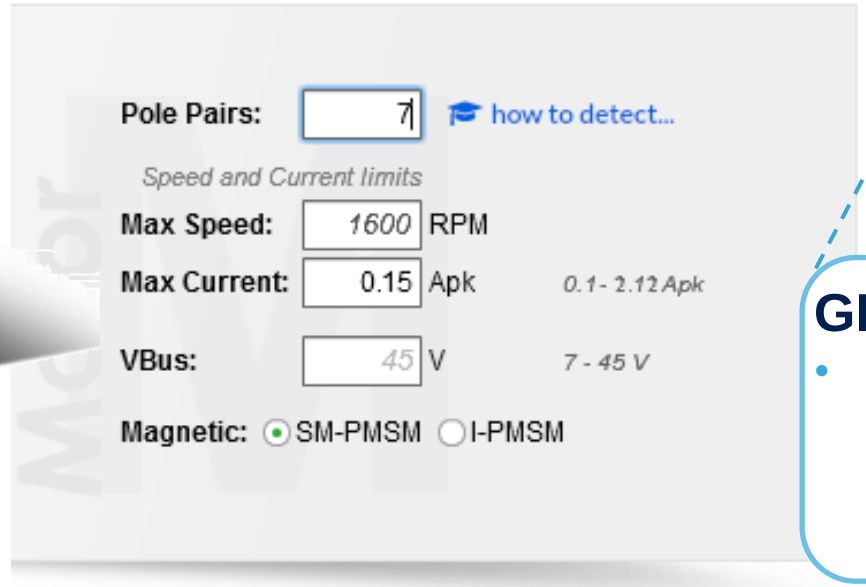
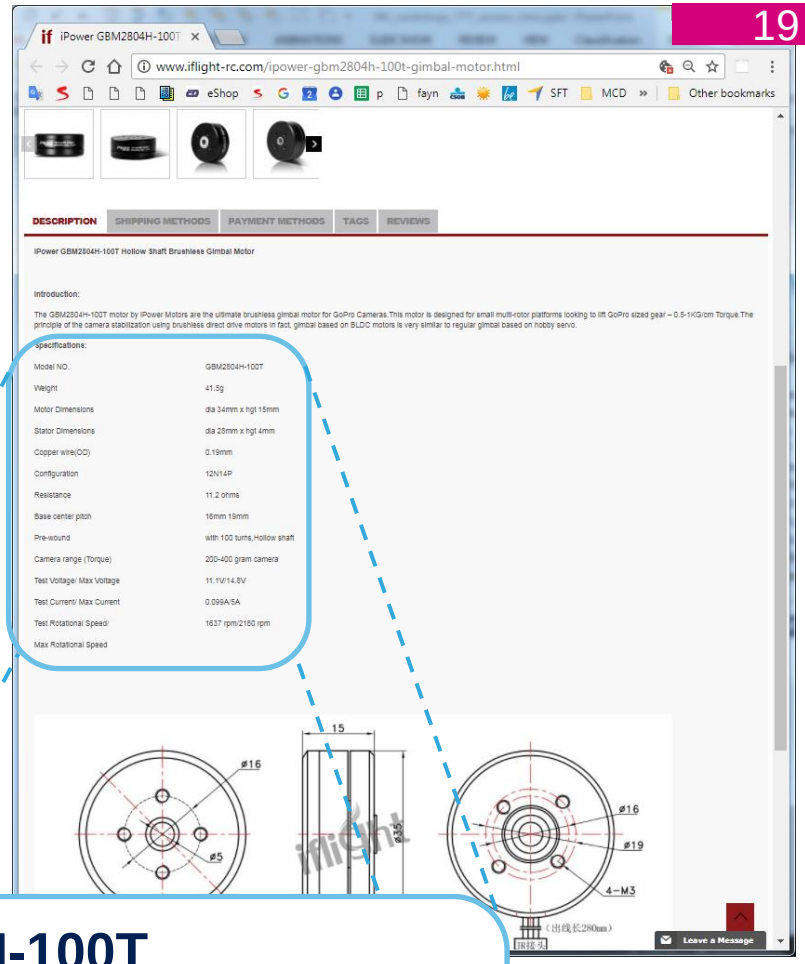
Hands-On section

ST Motor Profiler (MP) setup

- Few parameters shall be inserted by the user

- Motor pole pairs (mandatory) - **Fill your measured number of pole pairs**
  7 pole pairs
- Maximum application speed - **1600 rpm**
- Maximum peak current - **0.15 Apk** (zero to peak)
- Expected bus voltage - power plugs has 12V
  it is not necessary reduce it - let it empty
- Type of motor - we do not know
  use SM-PMSM





GBM2804H-100T

- 3-phase motor
  - 11.1V / 14.8V Test / Max Voltage
  - 0.099A / $5A_{RMS}$ Test / Max Current
  - 1637 / 2180 rpm Test / Max Speed
  - 12N14P Configuration

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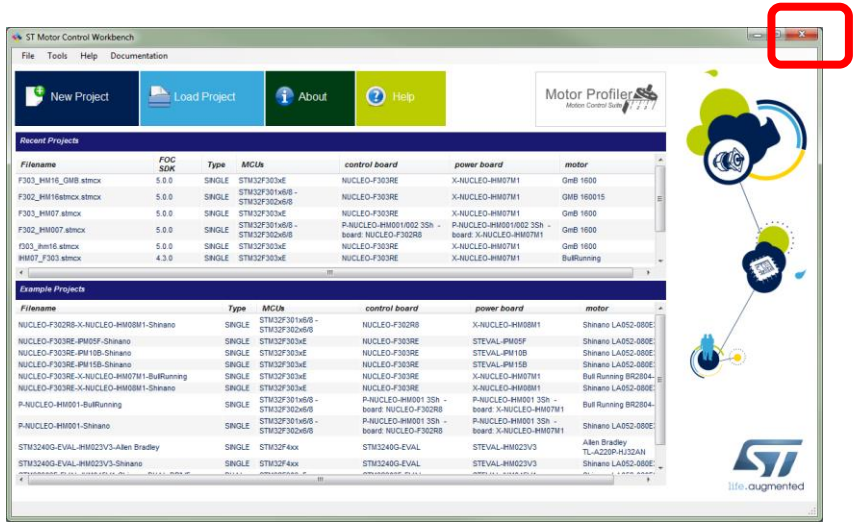
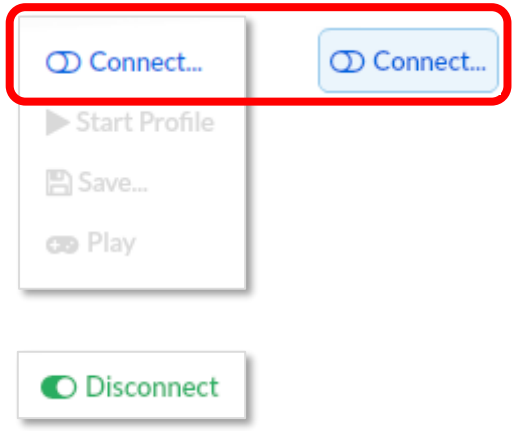
Connect MP to your Hardware

- Make sure to close the Workbench application
  - The Workbench can block the ST Link comunication



- Click on the “Connect” button
  - If communication with the board is successful, the icon and related text color will become green



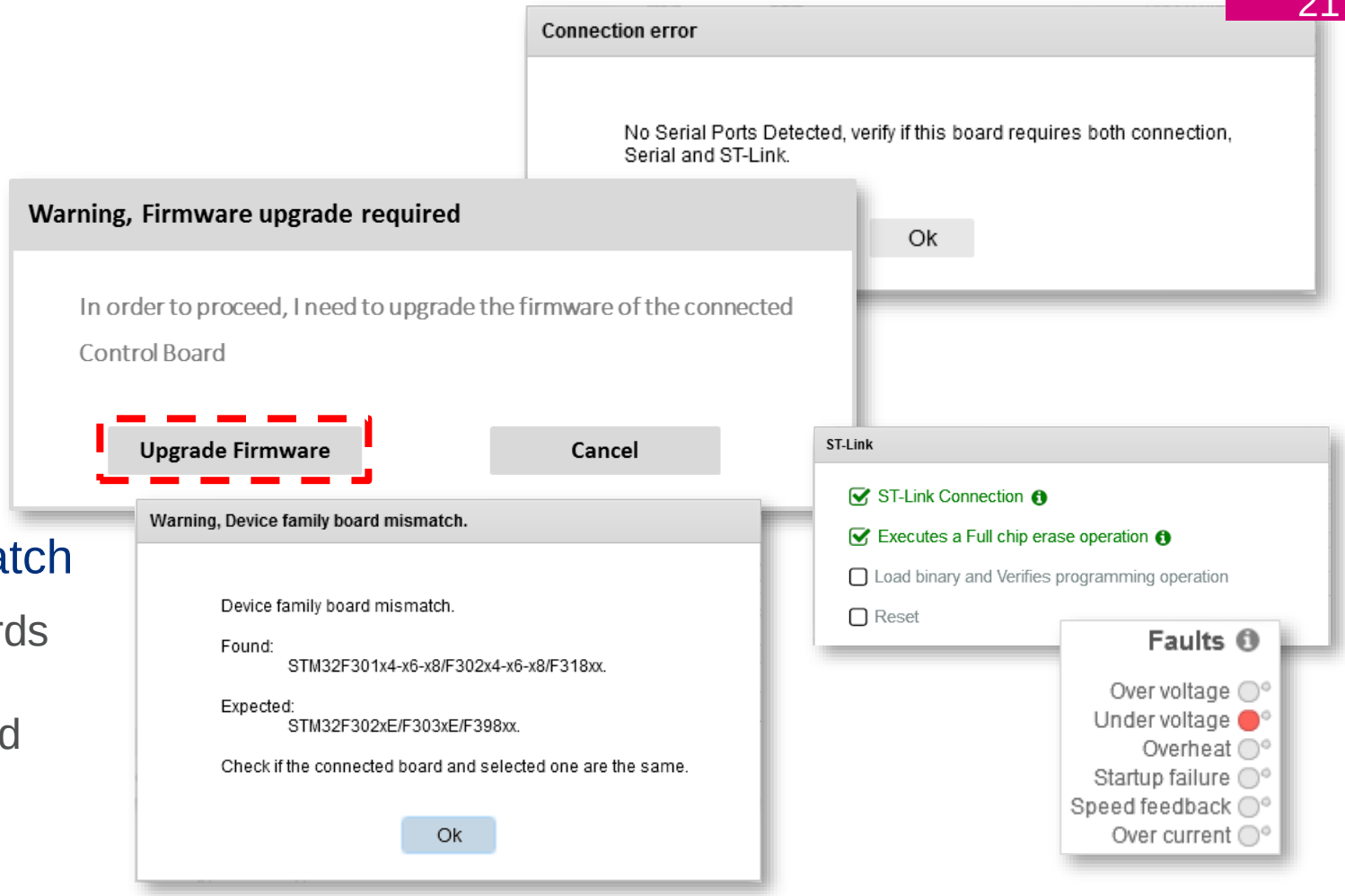
MP info / faults during the connection

- Connection error
  - Check the USB connection

- Warning, FW upgrade required
  - The MP needs proper FW, Confirm to Upgrade the FW

- Warning, Device family board mismatch
  - Return back to selection of the boards and select right board the „NUCLEO-F303RE“ and „X-NUCLEO-IHM16“

- Under voltage error
  - Check the setting of the power plug – 12V and the connection to your hardware



Please, follow the displayed instructions

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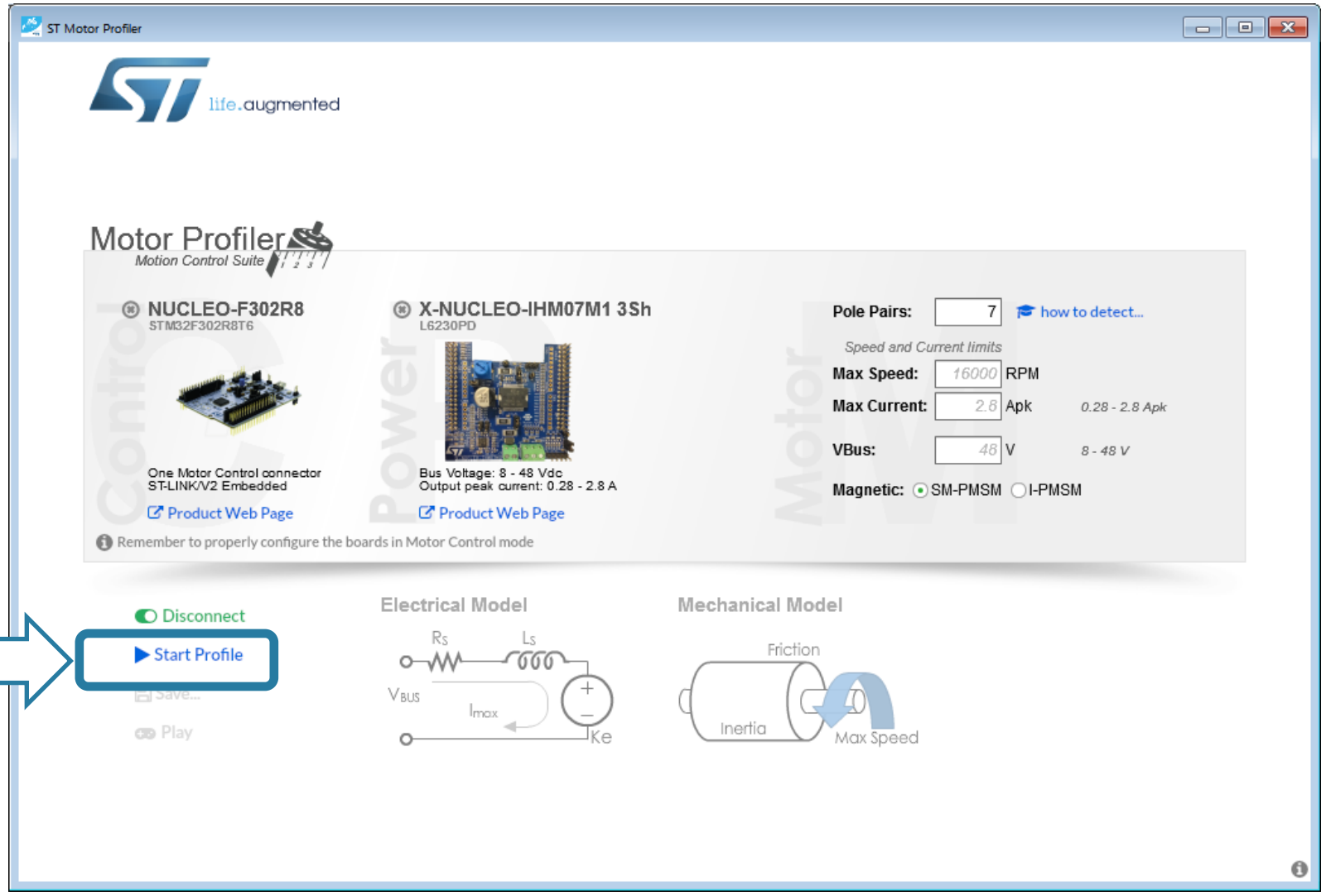
Hands-On section

Start Profiling



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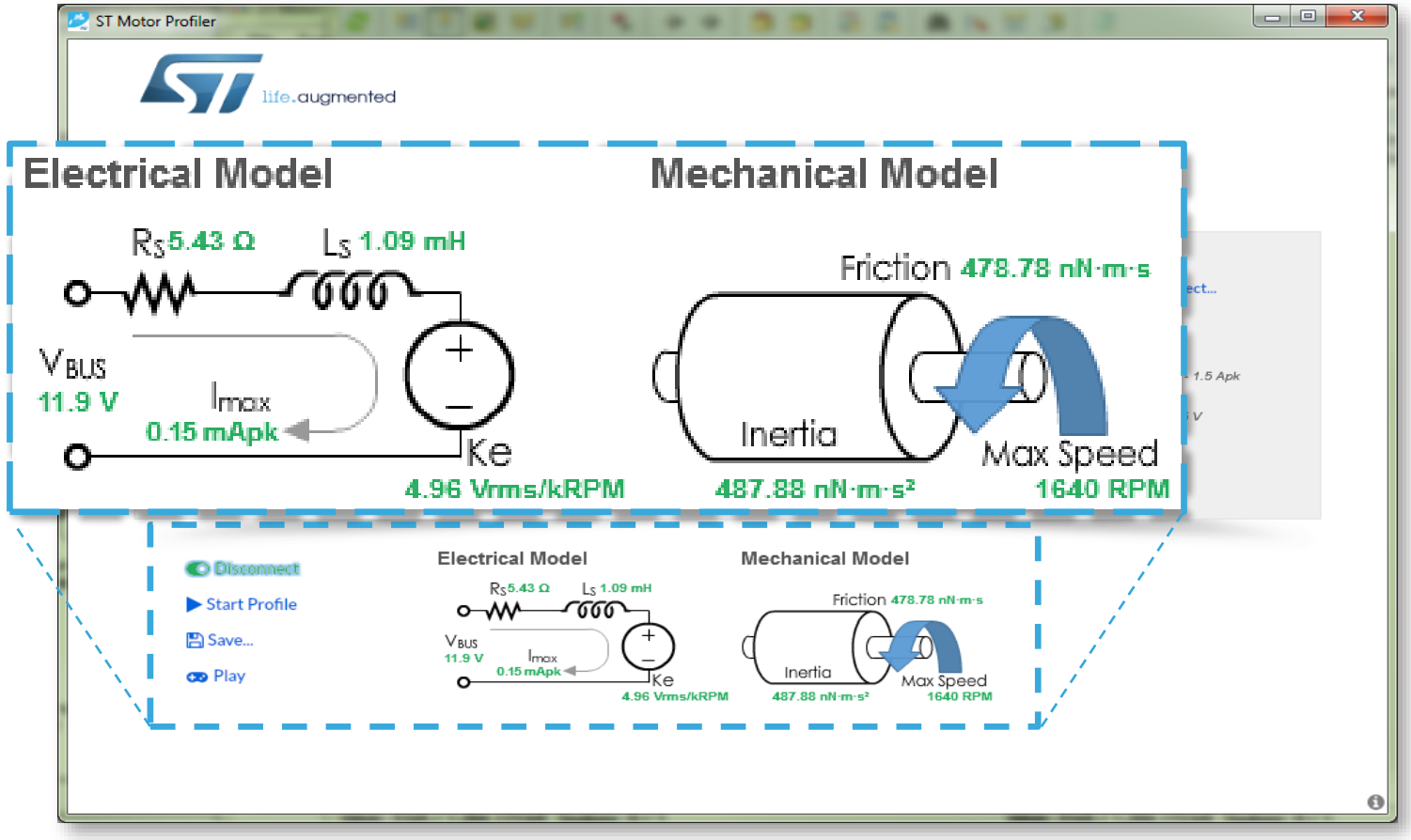
Hands-On section

Profiling and its results

- Motor Profiler finishes Profiling
- Electrical model at first
  - It can be restarted
    - with reduced current
    - with slower start-up ramp
- Mechanical model is next
  - It can be restarted
    - again with reduced current



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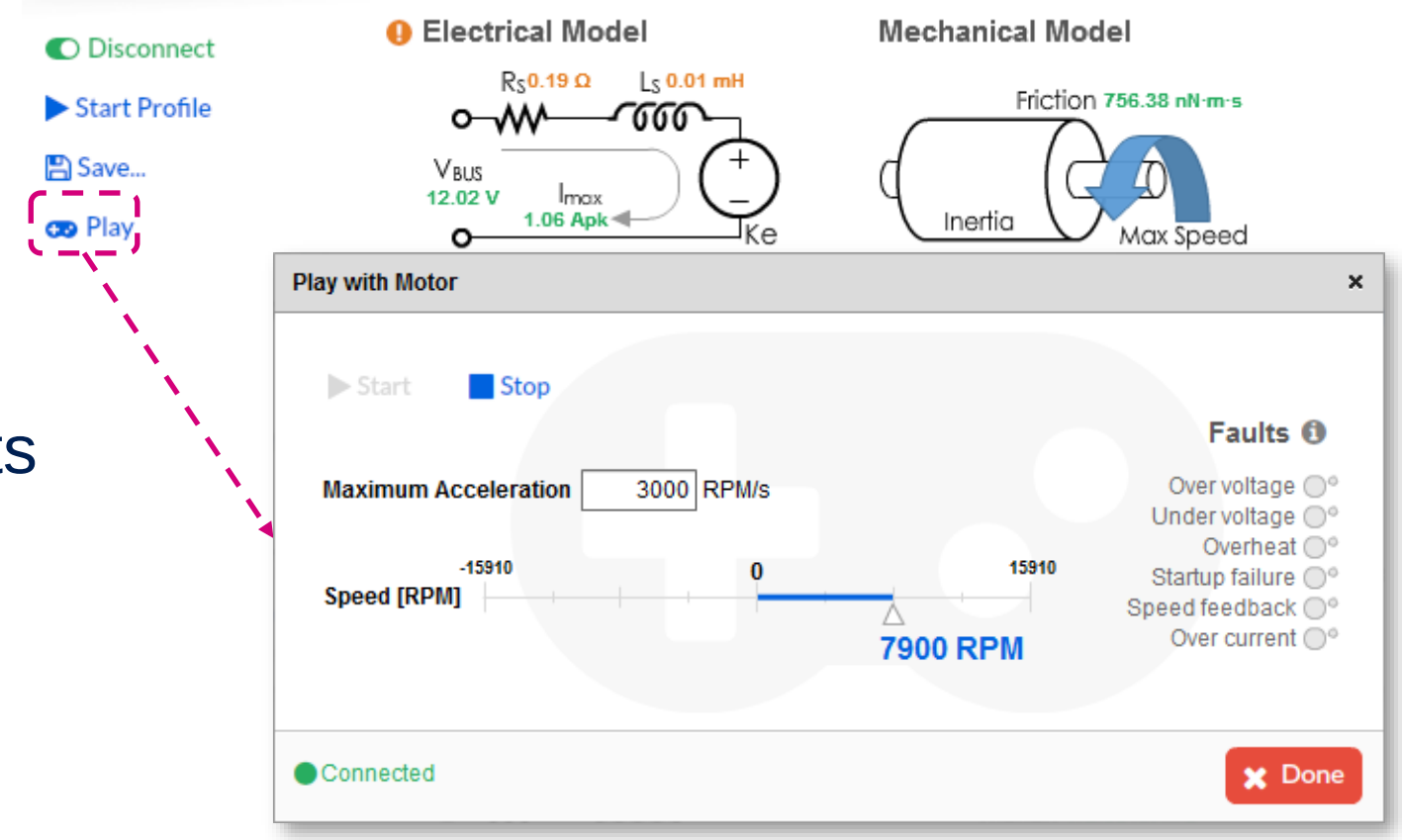
Hands-On section

Play mode

- You can „Play“ with the motor now
  - Start the motor
  - Control the motor’s speed
  - Reverse the spin direction
  - Modify the acceleration slope
- The „Play Mode“ handles faults and restarts motor if needed



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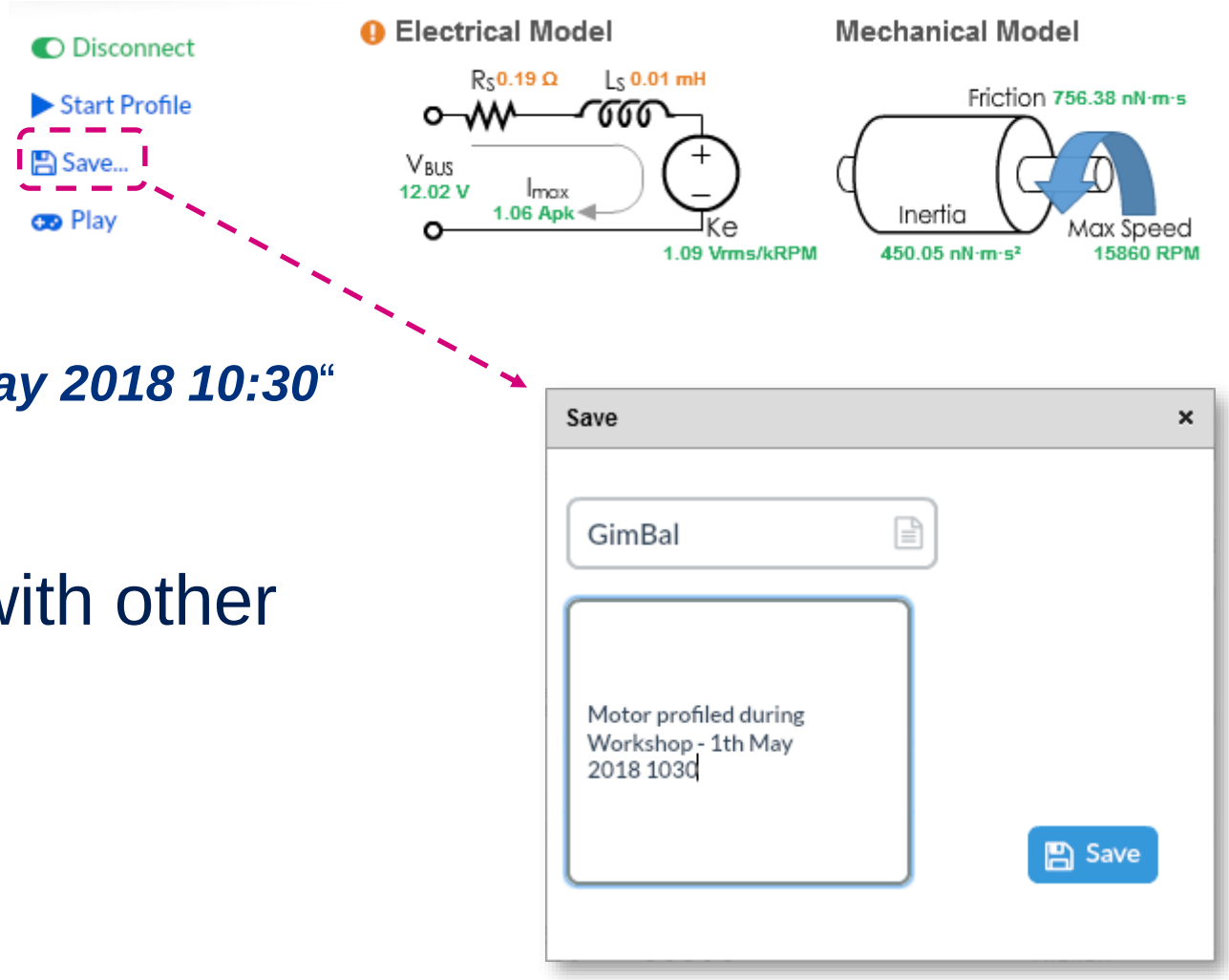
Hands-On section

Save motor parameters

- Save the observed parameters
  - Write down your name „***GimBal***“,

  and description of the motor
  „***Motor profiled during Workshop - 1th May 2018 10:30***“

- The parameters can be reused with other hardware in the future



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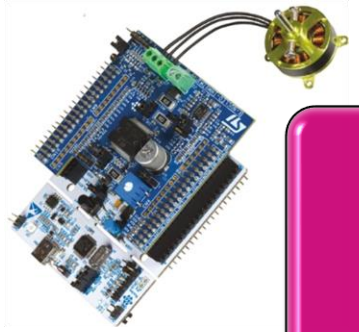
Hands-On section

Motor not recognized by Motor Profiler

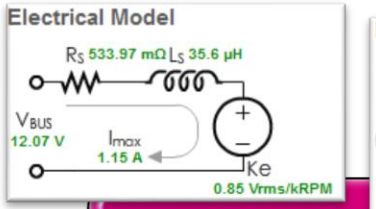
- Make sure the proper voltage is applied for this motor
- Use a power board with a proper voltage range for your motor (Low / High voltage)
- Select the power stage with the correct current range
- Reconfirm the pole pair number is correct
- Double or half the maximum motor speed parameter or play with this value
- Decrease the value of the maximum current parameter
- Hold motor in hand for better results (fix position)

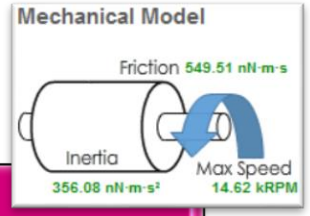
Motor Control Development Workflow

#2 – Motor Characterization



Hardware Setup





Motor Characterization

Motor Profiler
Motion Control Suite

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