HANDS ON
HOW TO TUNE A NEW PMSM
STEP BY STEP

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SECURE CONNECTIONS
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Agenda

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Overview

- The session will focus on "**How to tuning a customer motor**"

- The session will introduce the hardware, firmware, tuning tools

- PMSM FOC sensor-less configuration will be introduced

- Tasks will be executed step by step

- Assume you already have the basic knowledge on BLDC and PMSM

- Assume you know the six-step sensor-less and FOC

- If you are a fresh of motor control, you would also be benefit with the whole tuning procedure

Overview

• After the training,

❑ You can have a direct experience how motor control system works

❑ You can run a customer motor quickly and easily

How to start

- ## Hardware

  The session will use [MTRCKTSPNZVM128](#)

  MTRCKTSPNZVM128 = [S12ZVML12EVBLIN](#) or [S12ZVMC12EVBCAN](#) + Motor

- ## Software

  For PMSM, FOC sensor-less control [MTRCKTSPNZVM128 Software](#)

  For BLDC, six-step control [MTRCKTSBNZVM128 Software](#)

- ## Tools

  FreeMASTER 2.0 [download](#)

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How to start

- MTRCKTSPNZVM128 SCH overview

  Focus on current sampling, MOSFET driving, connectors and so on

- Check the motor wire and connection

- Check the power

- Codewarrior10.6

BLDC Sensor-less Hands On

- Check the jumper setting and make sure is correct, especially for the current sensing portion (J57 and J60)

  Refer MTRCKTSBNZVM128QSG

- Open the firmware in Codewarrior10.6, compiler and run

- Go though the firmware

- Control the BLDC via FreeMASTER, run/stop, speed up, speed down

- How to configure the parameters

PMSM Sensor-less Hands On

- Check the jumper setting and make sure is correct, especially for the current sensing portion(J57 and J60)

  Refer MTRCKTSPNZVM128QSG

- Open the firmware in Codewarrior10.6, compiler and run

- Go though the firmware

- How to tuning a customer PMSM

❏ PMSM parameters measurement

❏ How to configure the parameters in EXCEL

❏ The tuning guide

❏ The golden rule

PMSM Sensor-less Hands On

- PMSM parameters measurement

❑ Pole Pairs

❑ Rs

❑ Ls (Lqs and Lds)

❑ Ke

❑ Inertia (rotor + load)

- Refer AN4680

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- How to configure the parameters in EXCEL
- The tuning guide
- Refer "永磁同步电机无传感器磁场定向控制（FOC）调试指南"

PMSM Sensor-less Hands On

- Golden Rules – Step by Step

❑ Voltage Open Loop [V/F control] – Make sure the power portion is work fine

No need any current, position or speed feedback

❑ Current Open Loop – Make sure the current sampling is work fine

Set the open loop current and run motor in open loop, check the real current, is it correct and OK?

❑ Current Close Loop – Make sure the current loop parameters (KP and KI) is suitable

Speed loop is ignored, current loop is working

❑ Speed Close Loop – Make sure the speed loop parameters is suitable

Set the target speed and get the speed feedback, adjust the KP KI to get the best response

PMSM Sensor-less Hands On

- Task 1 - Voltage Open Loop

❑ Set the Ud = 0 and Uq to 0.5V (In Firmware)

❑ Set the target speed to 200RPM (In FreeMASTER Interface)

❑ Change the position to the open loop mode (In FreeMASTER Interface)

❑ Go…

❑ Motor should run in 200RPM

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- Task 2 - Current Open Loop

❑ Recovery the firmware to the original one

❑ Set the open loop current to 1A (In firmware)

❑ Set the target speed to 200RPM (In FreeMASTER Interface)

❑ Change the position to the open loop mode (In FreeMASTER Interface)

❑ Go…

❑ Motor should run in 200RPM, and the current should be 1A

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- Task 3 - Current Close Loop

❑ Recovery the firmware to the original one

❑ Set the Iqref = 0.6A (In firmware)

❑ Set the RefSpeed = 2000RPM (In FreeMASTER Interface)

❑ Set the control mode to automatic (In FreeMASTER Interface)

❑ It actually the torque mode, the speed loop is bypass

❑ The motor will run and keep the Iq = 0.6A, we can check the Iq value in FreeMaster

❑ If the motor speed is too high, just give some load to the motor

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- Task 4 - Speed Close Loop

❑ Recovery the firmware to the original one

❑ Set the target speed to 6000RPM (In FreeMASTER Interface)

❑ Set the control mode to automatic (In FreeMASTER Interface)

❑ Check the real speed with target speed, how about the speed response

❑ Try to add some load to the motor

Summary

- Now, we have the confidence to run the customer's motor!

- FOC control is motor parameters dependence

- Six step control is independent with motor parameters

- Configuration the parameters is the key to motor control application

- Follow the rule, we can run a motor in sensor-less FOC mode in few hours