Sensorless Control and Drive methods for Permanent Magnet Motors

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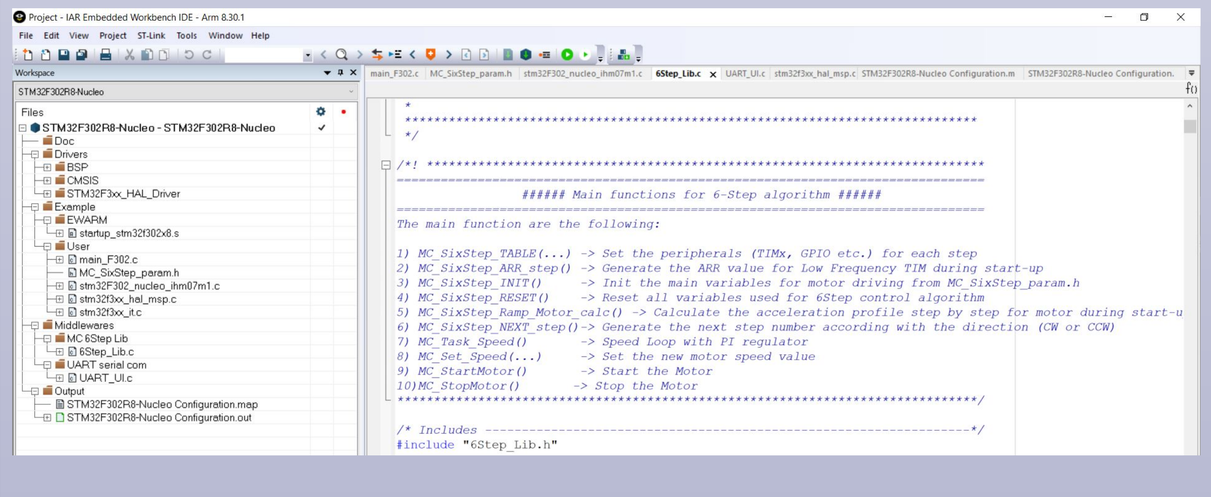
ABSTRACT

This paper presents driving method and sensorless control for BLDC motor. It includes general working principle of brushless DC motor in theoretical level mostly on back EMF generation. Then, using the relationship between zero crossing points with back EMF , procedure of sensorless control is explained. Later, electronic processor stm32F302 is present and example code is examined.

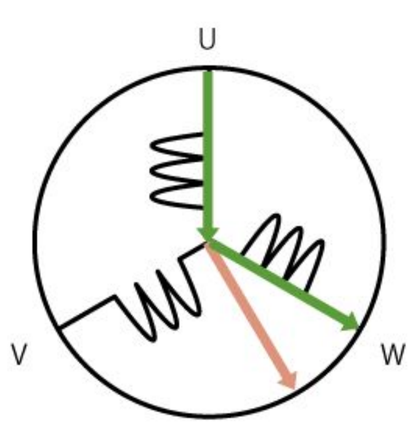
OBJECTIVES

- Running the motor with Stm32f302r8 and IHM07M1.
- Reading articles to understan the working principle of the motor
- Understanding the software algorithm of BLDC motor controlling sensorless
- Trying to start the motor with compiling our own code
- Transfer the software of the project kit to open source area
- Controlling different BLDC motors with different development boards such as STMF103 and new motor drivers
- Using UART communication



We used an IDE of IAR EWARM which lets us compile debug and send our code to our microprocessor. For the coding we used an example project from STMicroelectronic's website. This project includes all the low level coding files which are called hardware abstraction layer. Using some of these HAL files and its functions another file is created. These files has such functions that only calls another hal driver function. Purpose is to create a layer between just renaming. Other functions are for creating more functionalities by combining two or move functions. Overall whole project is created layer by layer to control motor. By knowing the properties of layer it can be changed or rewritten in a code like we use which is approximately 15000 lines long. Another important thing is general loops that repeat itself by each millisecond by using the ticks of internal clock. These loops has their own purposes, one of them reads the values like temperature and back EMF another loop generates PWM according to values of back EMF. With these loop instant measurements and decisions are made.

HARDWARE DETAILS



Energizing Mode	Energized Phase	Resultant Flux
1	U → W	
2	U → V	
3	W → V	
4	W → U	
5	V → U	
6	V → W	

Digital Image

When the motor starts to spin , the rotor which is moving around inside the stator coils, induces an electrical potential in the stator coils. This is called BEMF. After the design and production of the motor, Bemf depends on the angular velocity of the rotors. "Bemf waveform is fairly linear and passes through a voltage that is exactly half of the applied voltage at precisely 60 degrees which coincides with the zero crossing points.At various duty cycles, the driven curve always equals half the applied voltage at 60 degrees."(Brown, 2002) Based on this information, the rotor electrical position can be determined by detecting Bemf when the open terminal voltage equals half of the applied voltage. It is possible to indicate that the shifts in zero corssing points can be sensed and used in order to regulate the commutation rate to keep the motor running at the constant velocity with load torque and applied voltage.

CONCLUSIONS

In this report building blocks of controlling a motor is presented. For each block an example application or tool is shown with pictures and instructions. Especially back EMF is explained in details since knowing the characteristic of back EMF and processing it provides sensorless control for BLDC motor. We used a st microcontroller which has a built in detection circuit for back EMF. Also st has example motor control project that we send to microcontroller which does necessary processing. In the end we have better understanding at how a BLDC motor rotates mechanically and with the help of an example code we go in detail and examine the flow of coding and see necessary values and functions. For the future work we now can improve the code and make proper adjustments to chance 6 step commutation to more like a field oriented control.

REFERENCES

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