**PMSM Lab**

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**ITMO ID:375334**

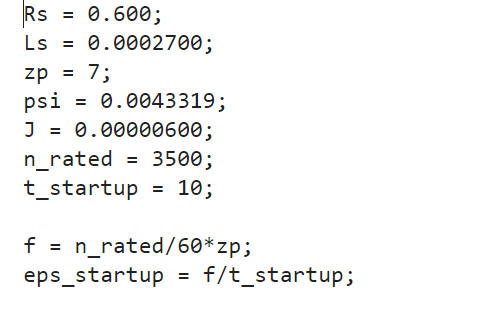
**HDU ID:22320404**

**TASK 1.BUILD THE MECHANICAL PART OF THE MODEL BASED ON DIFFERENTIAL EQUATIONS**

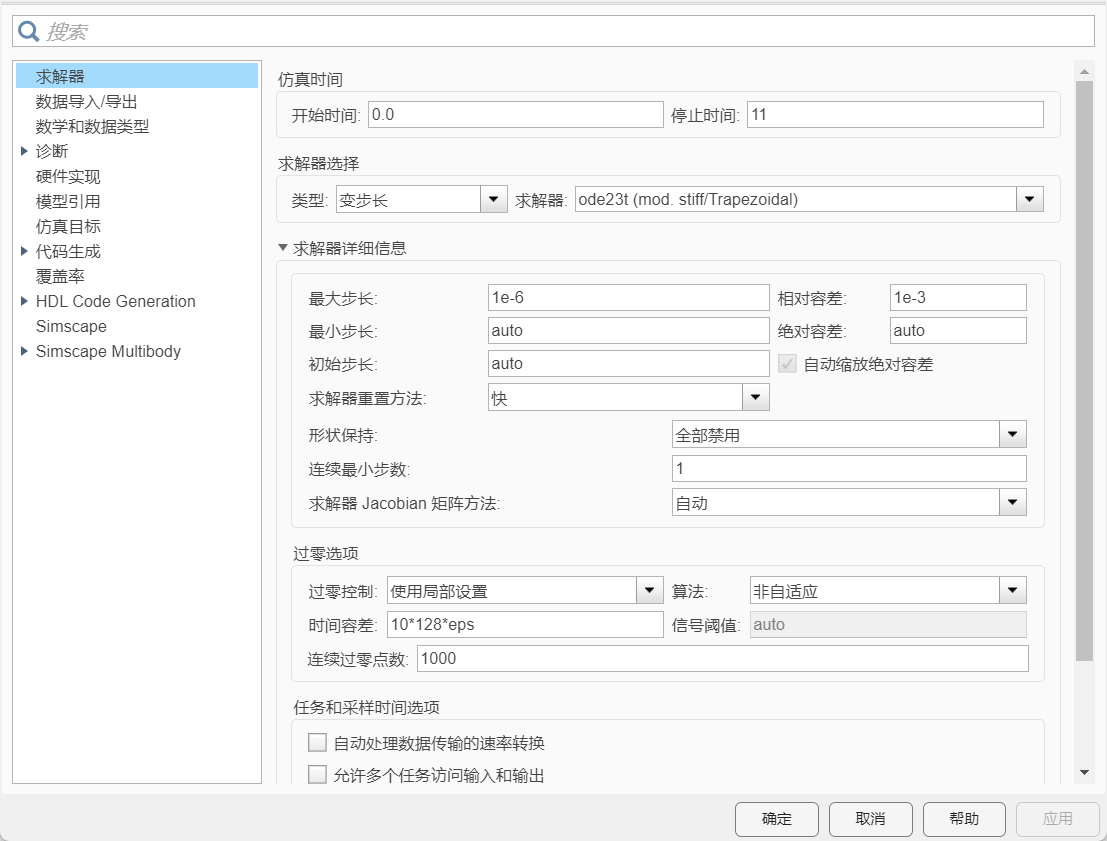
**1.DATA INITIAL**





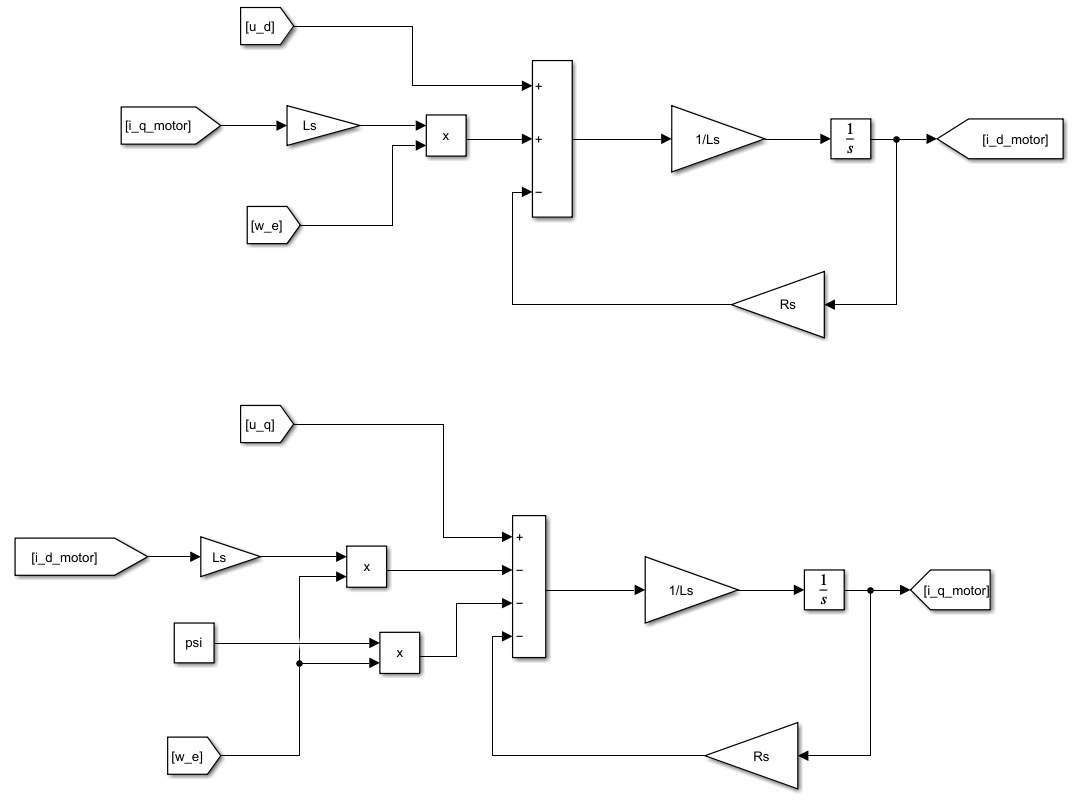


**2.MODEL CONFIGURATION**

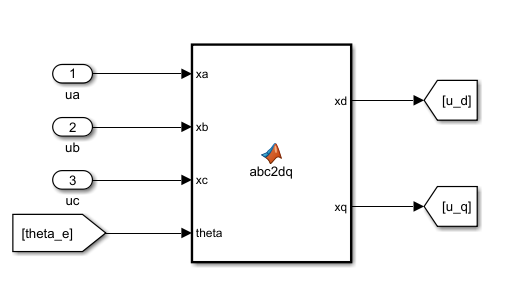
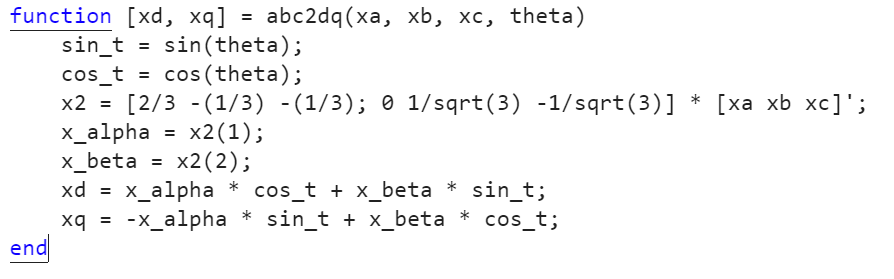


1. **The model of SPMSM based on differential equations**

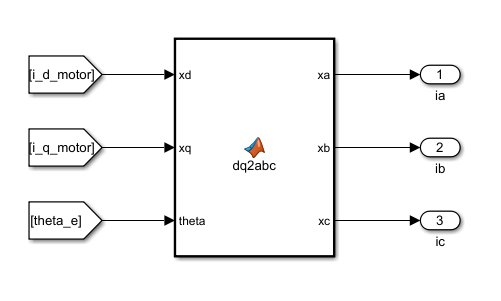
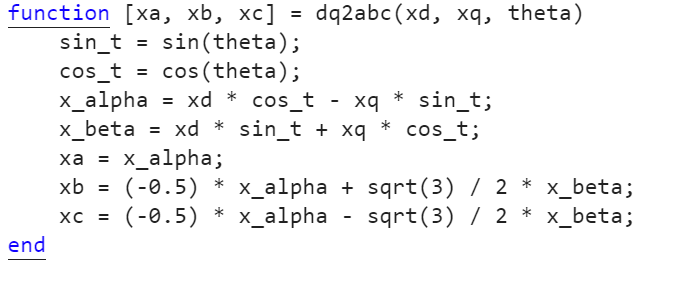
**Block diagram of d-q equations**



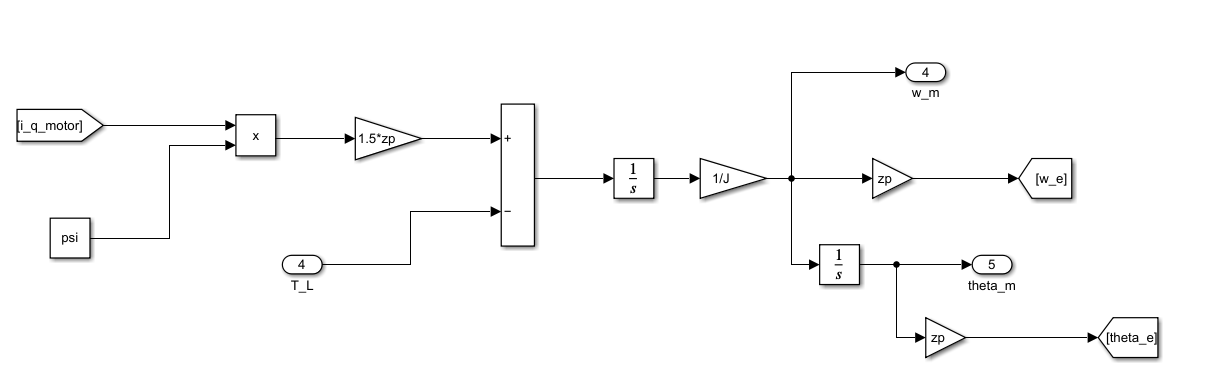
**Input Clark & Park transformation:**

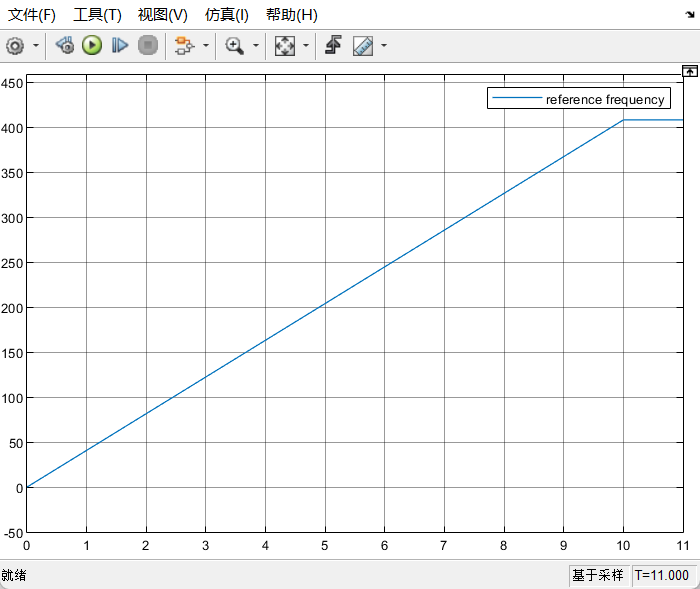


**Output inverse Park & Clark transformation:**

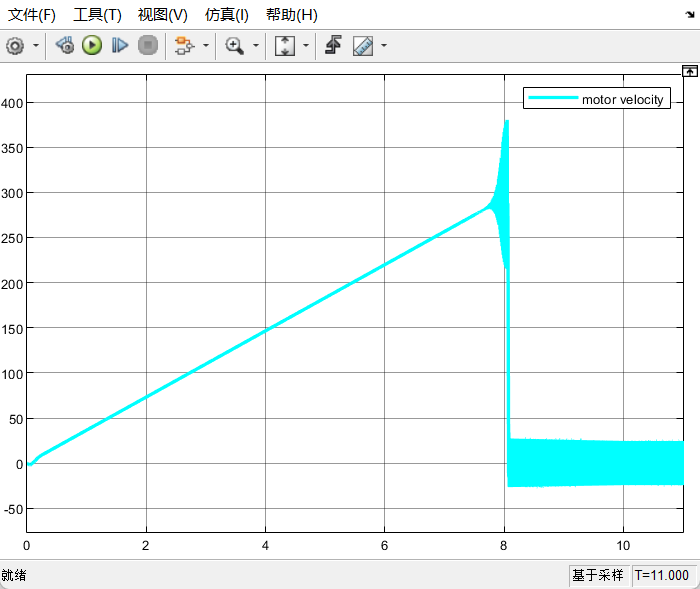


**Mechanical part:**

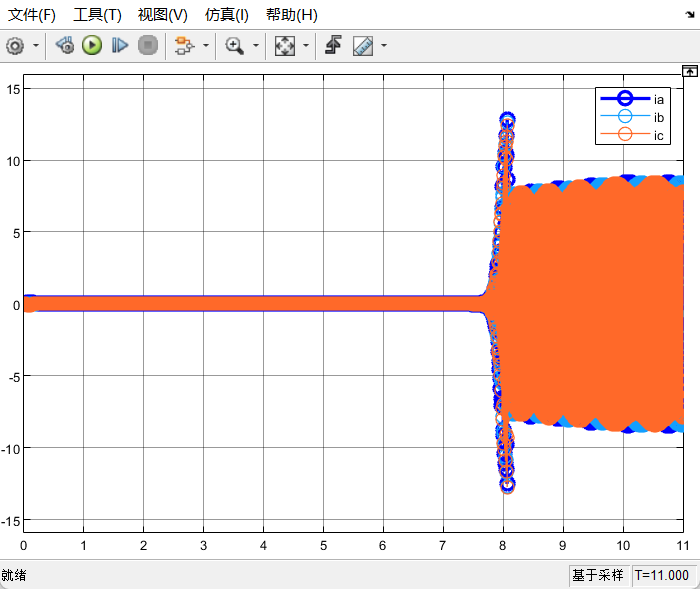




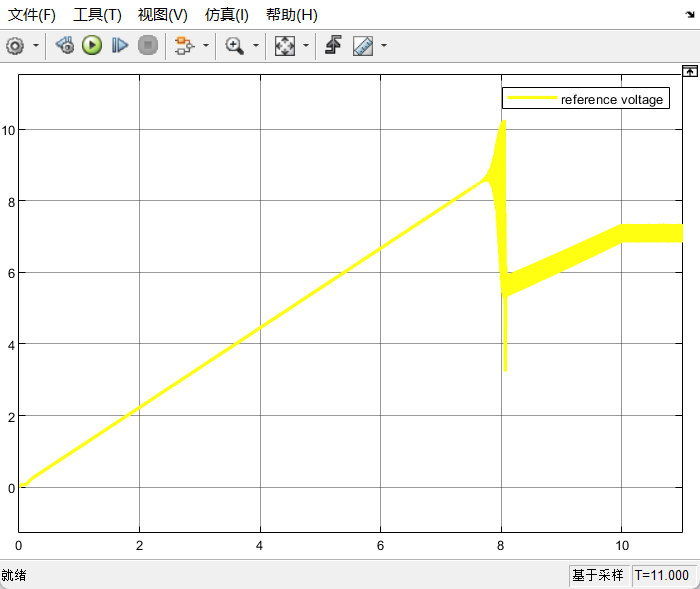
1-reference frequency



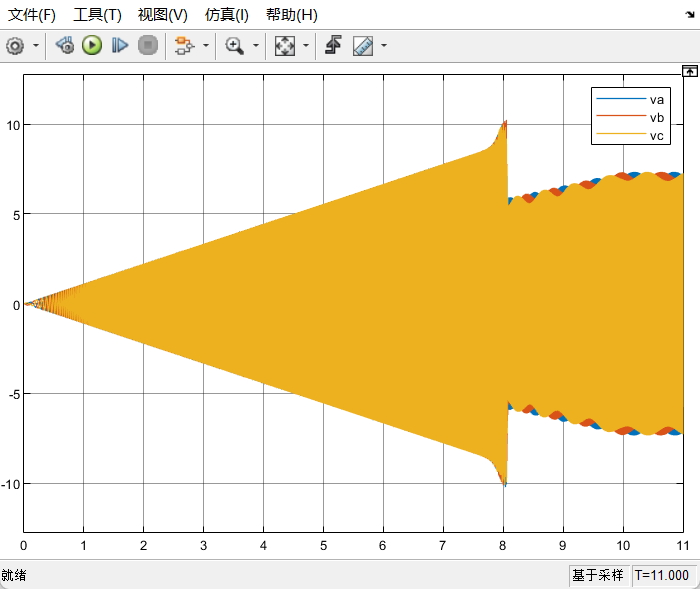
2- motor velocity in rev/min



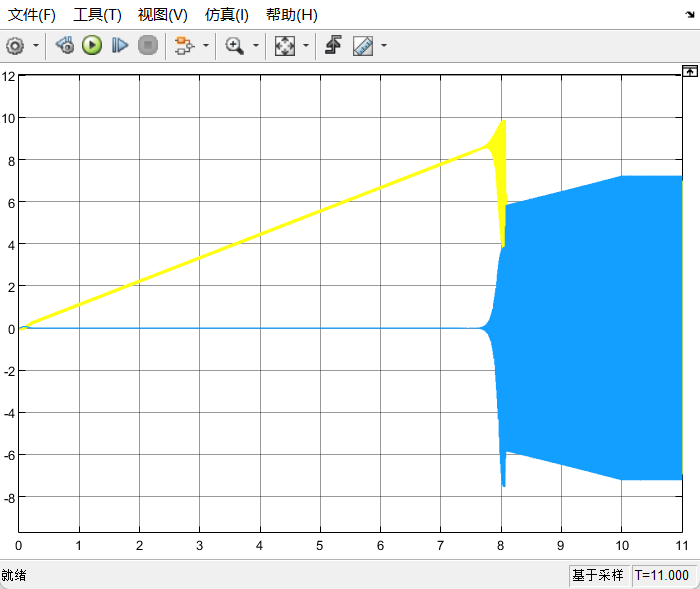
3-phase currents ia, ib, ic,



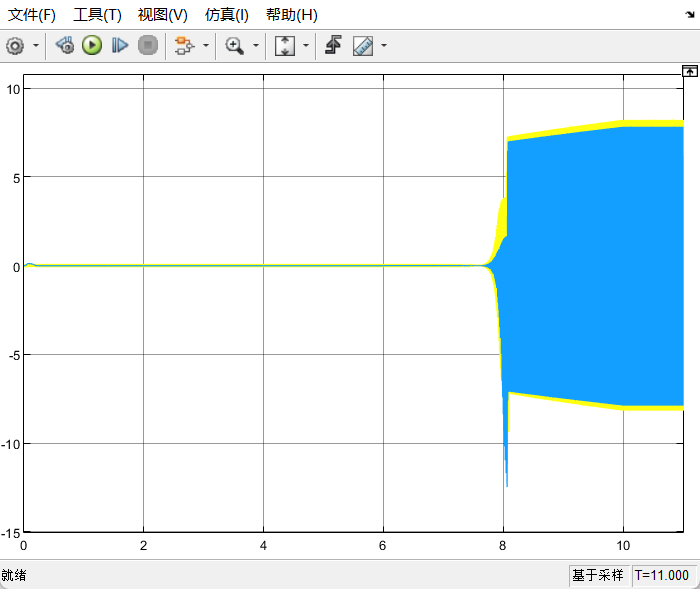
4-reference voltage vs\*, V



1. phase voltages va, vb, vc, V

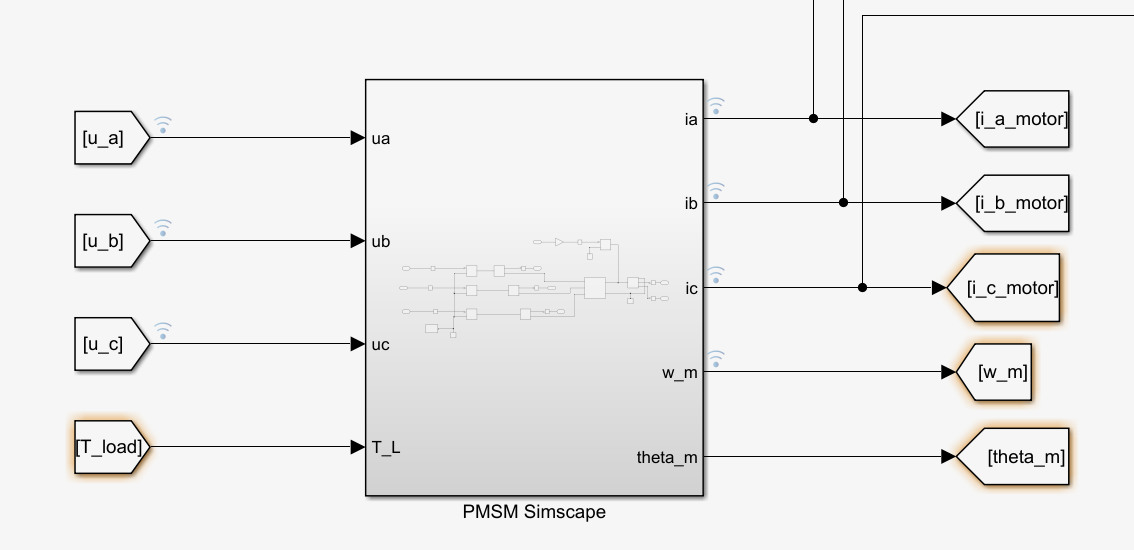


6-dq-voltages, V

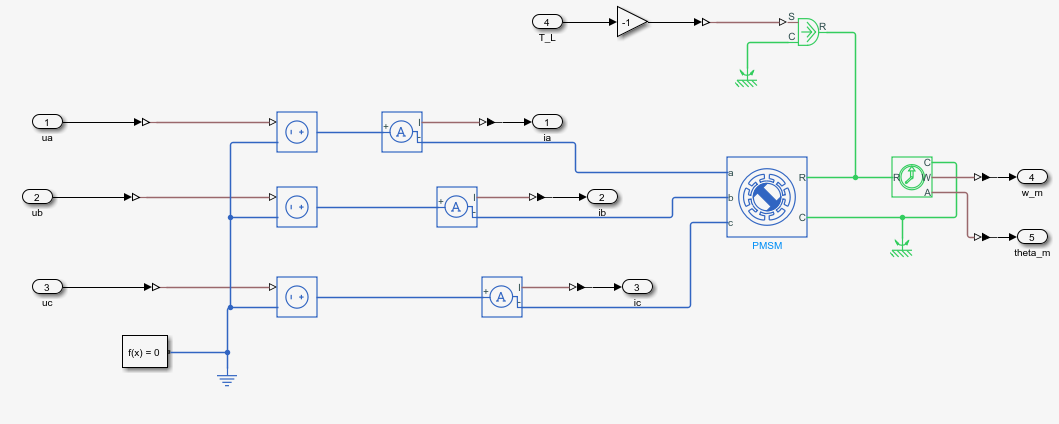


7-dq-currents, A

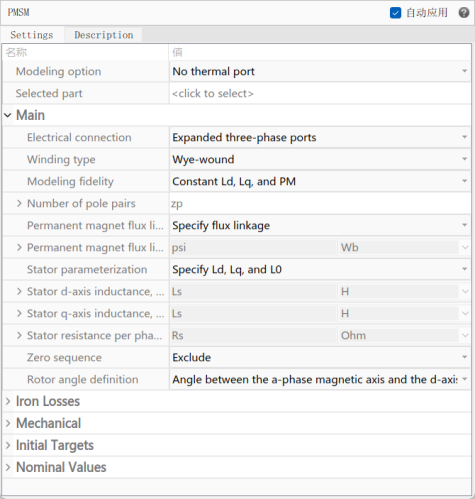
**TASK 2.BUILD THE MECHANICAL PART OF THE MODEL BASED ON SIMSCAPE MODEL**

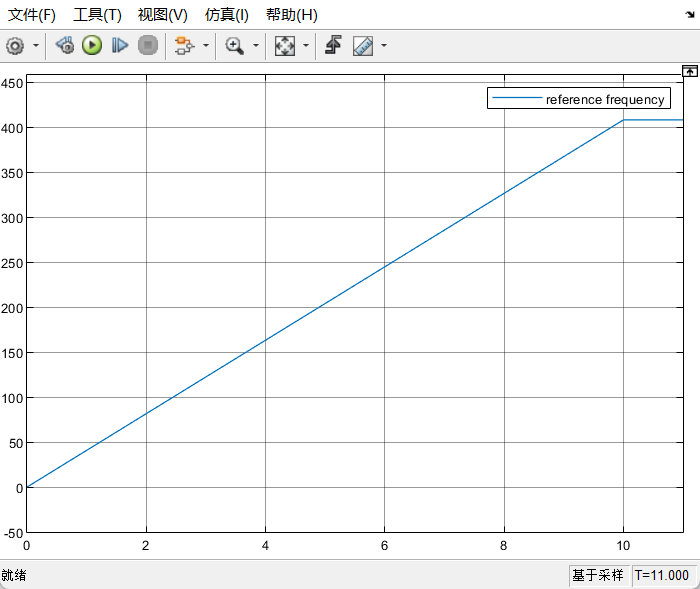


**1.Model build**

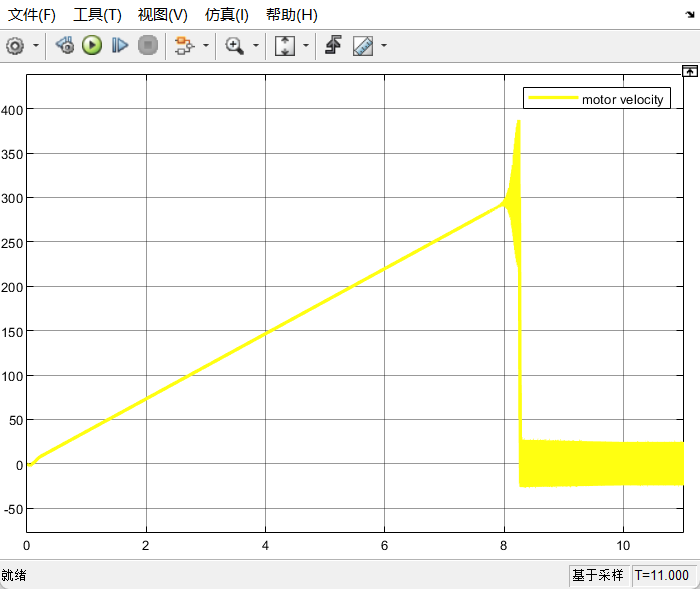


**2.Motor parameters setting**

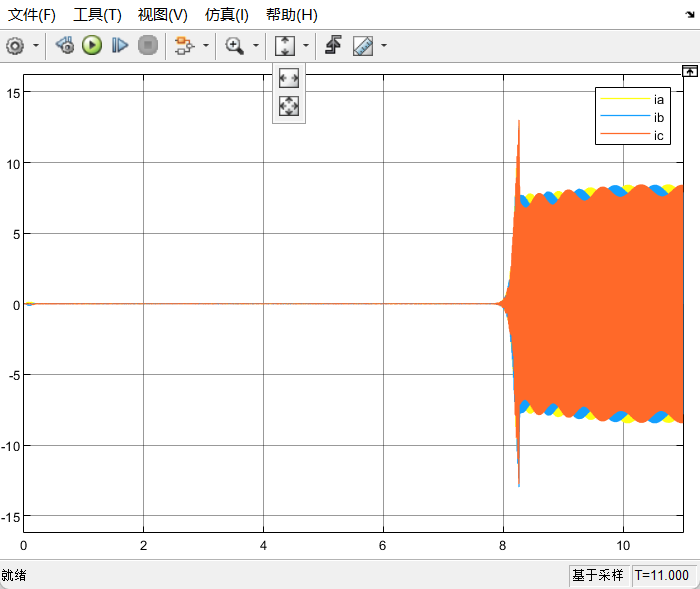




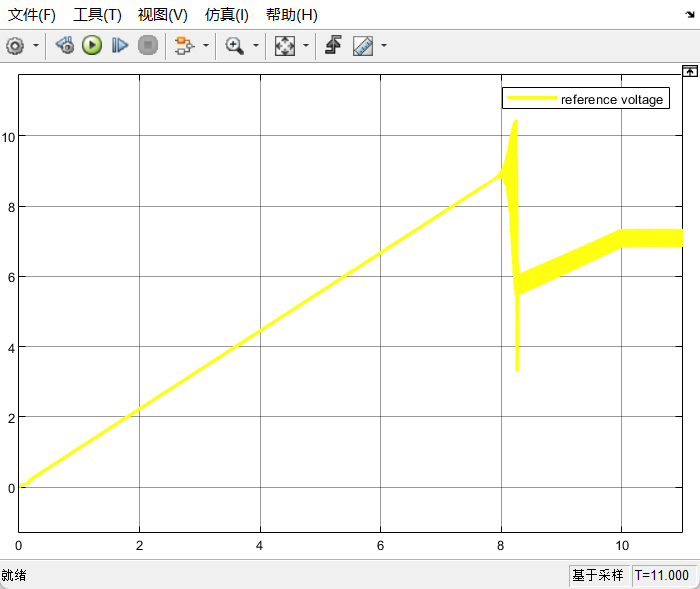
**1-reference frequency**



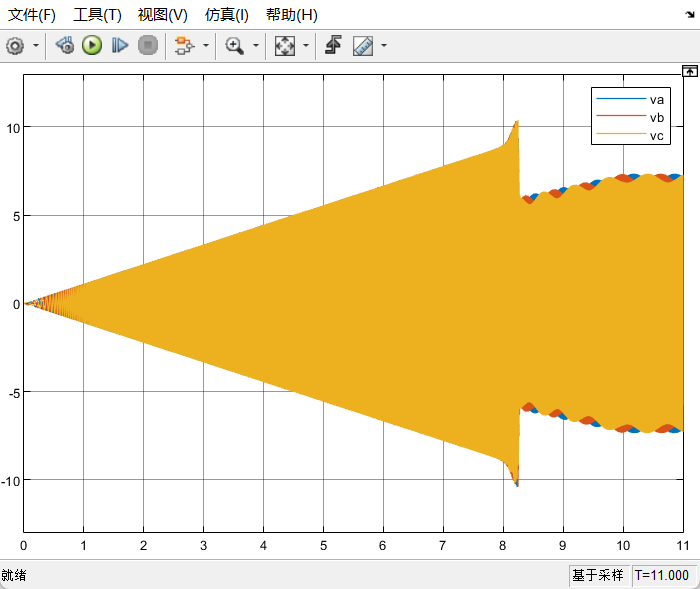
**2-motor velocity in rev/min**



**3--phase currents ia, ib, ic, A**



**4-reference voltage vs\*,V**



**5-phase voltages va, vb, vc, V**

**Conclusion:**

The lab examined two distinct methods for modeling motor behavior: one using differential equations in the d/q reference frame and the other utilizing Simscape.

Both approaches considered the motor's electrical and mechanical dynamics to evaluate its performance. The experiment concluded with a voltage control strategy, specifically the V/f startup method, to regulate motor speed. Simulations of no-load startup were run for both models, and the results showed similar behavior. However, the V/f controller was unable to drive the motor to its rated speed. After about 8 seconds, oscillations appeared in both the reference voltage and motor speed, signaling a loss of synchronization. As the slip increased, the motor speed dropped toward zero and continued oscillating, never achieving the rated rotational speed.