

IM Report

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TASK1 for 08/10/2024 «Modelling 3phase induction motor»

1. Create model of induction motor that supplied by 3ph source " 01 Task_Asynchronous Machine_modelling_and_remarks.pdf"

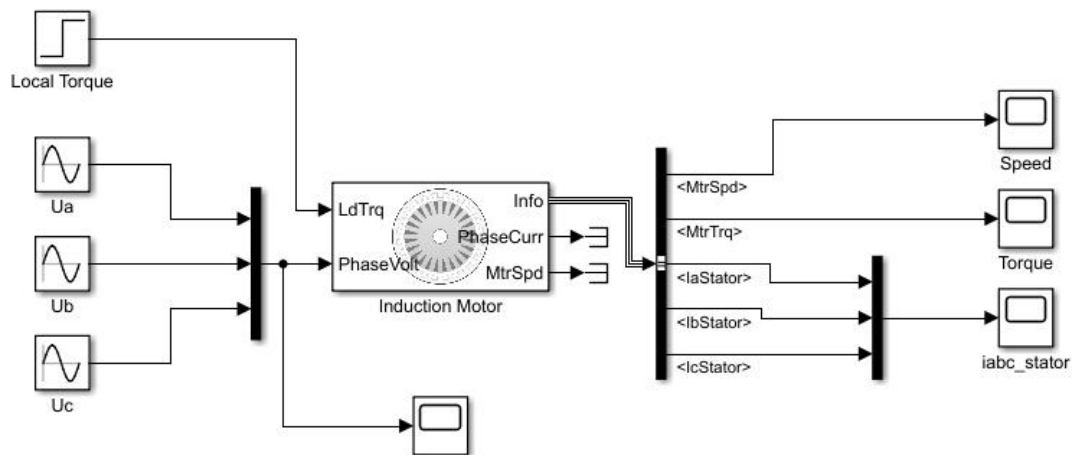


Figure 1. The Model of Induction Motor

2. Use data in block of "Induction motor" " 01 Task_Asynchronous Machine_modelling_and_remarks.pdf"

模块参数: Induction Motor

Induction Motor (mask) (link)

Models a three-phase induction motor (IM). Uses the three-phase input voltages to regulate the individual phase currents, allowing control of the motor torque or speed.

Block Options

Simulation type: Continuous

Port configuration: Torque

Load Parameter Values:

File: Browse

Parameters Initial Values

Number of pole pairs (P):	2	:
Stator resistance and leakage inductance (Zs):	[1.77 0.0139]	: [Ohm, H]
Rotor resistance and leakage inductance (Zr):	[1.34 0.0121]	: [Ohm, H]
Magnetizing inductance (Lm):	0.3687	: [H]
Physical inertia, viscous damping, static friction (mechanical):	[0.095 0 0]	: [kgm ² , Nm/rad/s, Nm]

Figure 2. The Data of Introduction Motor

3. Use data in blocks of "sin wave source" " 01 Task_Asynchronous
Machine_modelling_and_remarks.pdf"



Figure 3. The Data of Three Blocks of Sine Wave

4. Simulate start of the motor and shown figures of speed, torque, stator's currents (figure 4 in report)

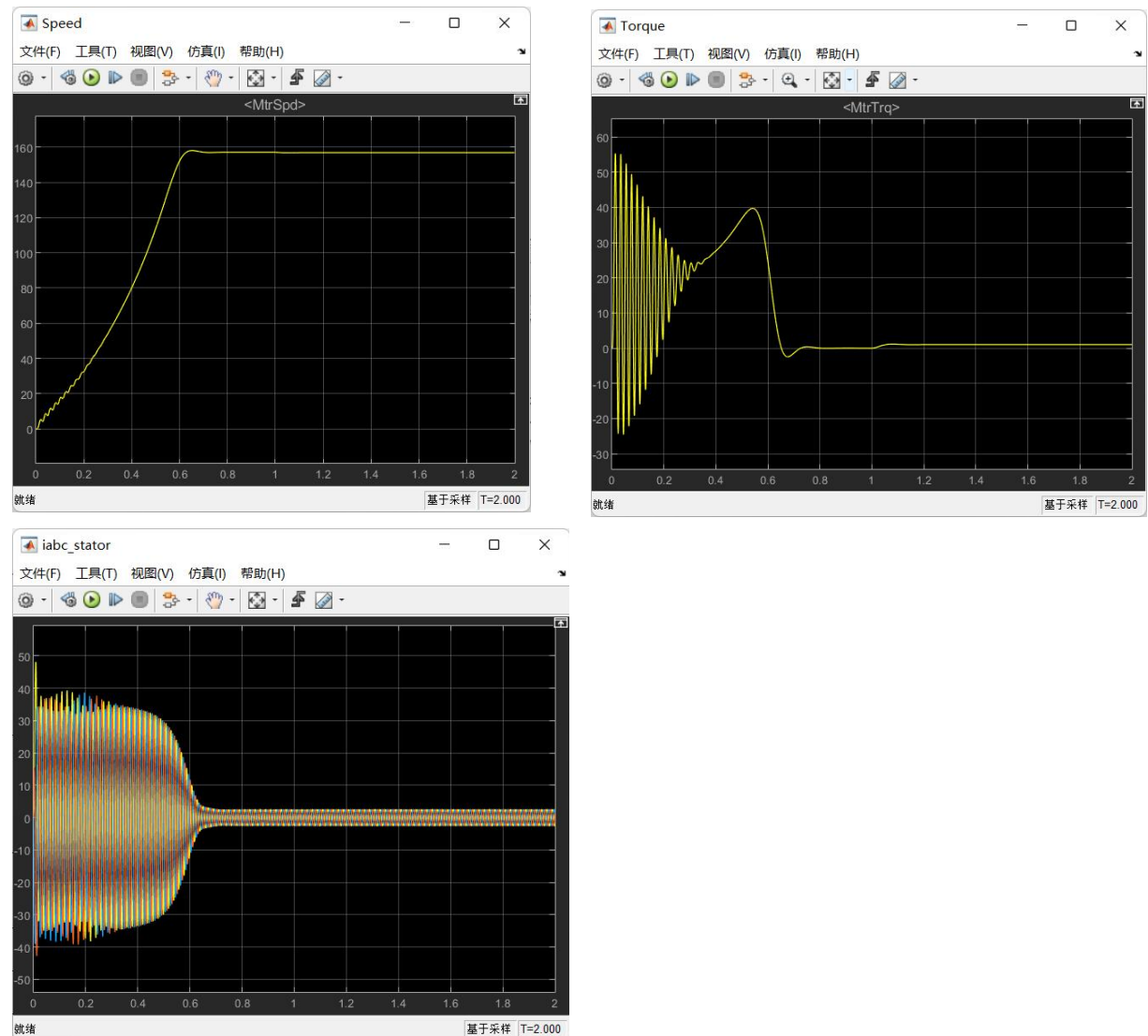


Figure 4. Start motor: motor transients (speed, torque, currents) when connected to a three-phase power supply (moment of inertia $J=0.095$)

Please calculate value of no-load speed (synchronous speed) and insert formula in your report and compare with value of steady-state speed in your figure

$$P' = P \cdot 2 = 4$$

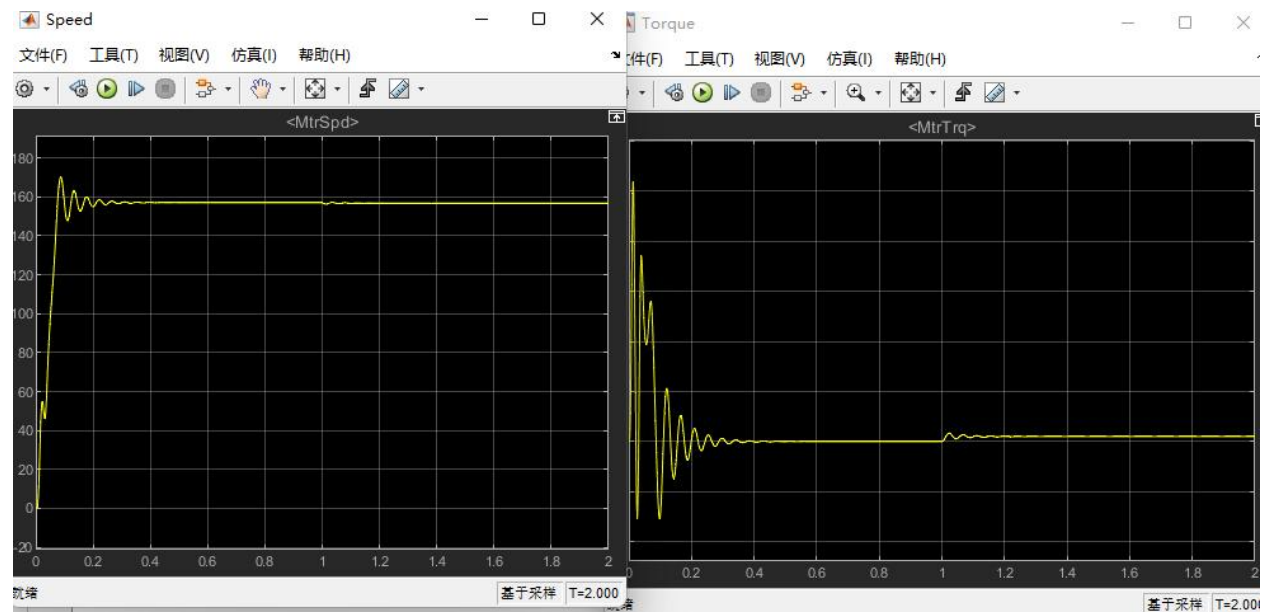
$$n_s = 120 \cdot \frac{f}{P'} = 120 \cdot 100 \cdot \frac{\pi}{4} = 157(\text{rad/s})$$

The calculated value is 157 and it is near the value of steady-state speed in the graph.

5. Change the moment of inertia (put it down its value) and show figures of speed, torque, stator's currents

Speed of the motor:

Torque of the motor:



Current of the motor:

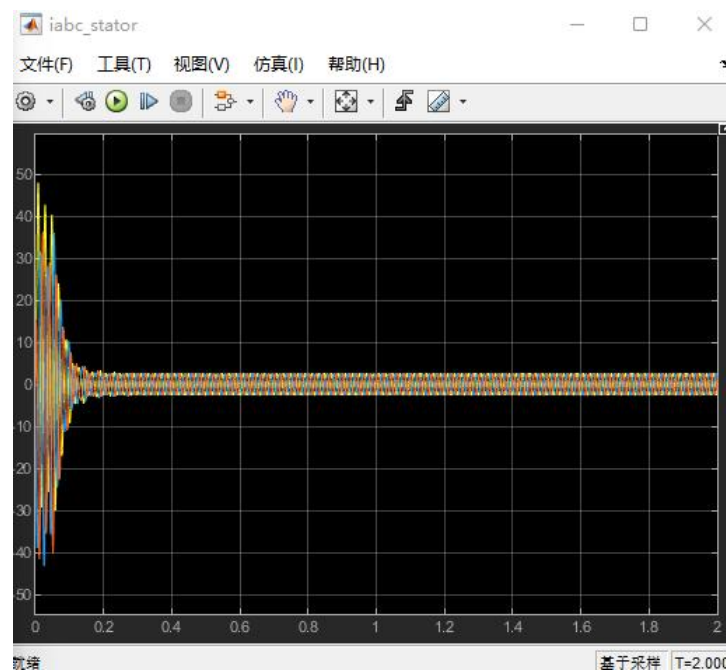
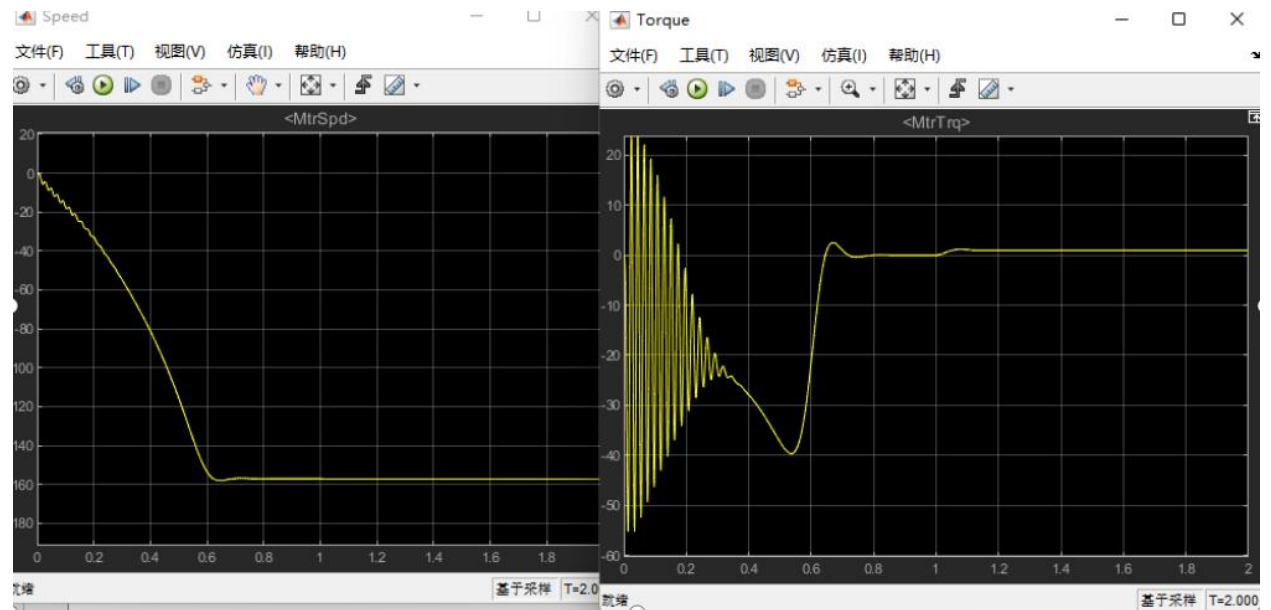


Figure 5. Motor with small moment of inertia: motor transients (speed, torque, currents) when connected to a three-phase power supply (moment of inertia $J=0.01$)

6. Change the direction of speed (change the direction of speed (this can be done by swapping any two source terminals))

Speed of the motor:

Torque of the motor:



Current of the motor:

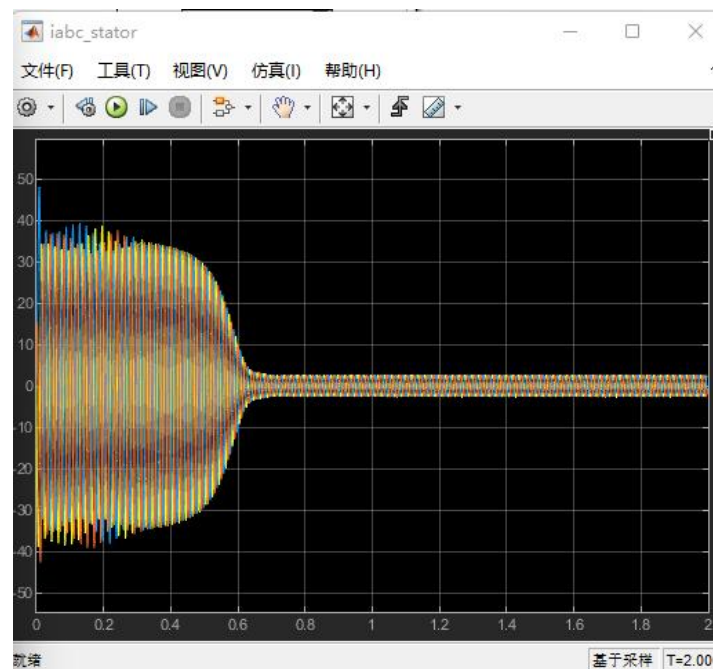


Figure 6. Motor with different direction of speed: motor transients (speed, torque, currents) when connected to a three-phase power supply (swap U_a and U_b)

7. Simulate start of the motor and shown figures of speed-to-torque curve using XY-graph (figure 7 in report)

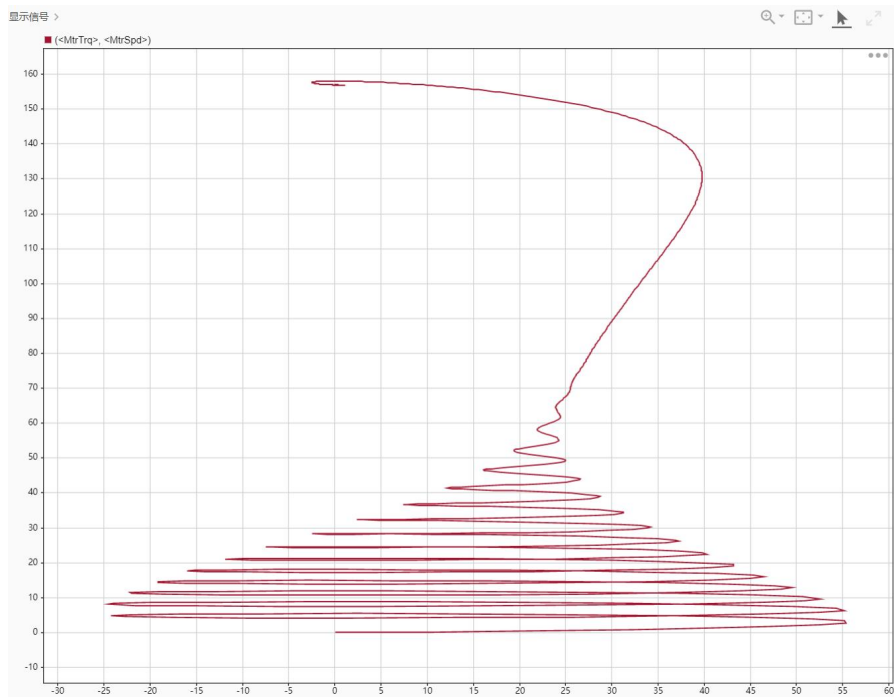
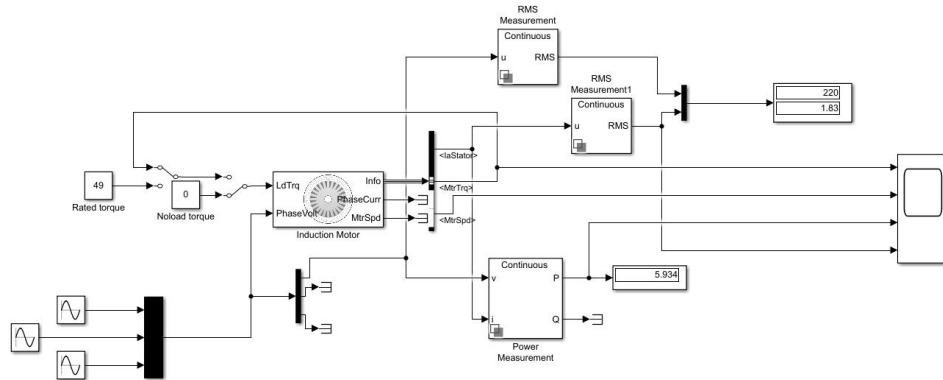


Figure 7. Start motor: XY-graph of speed-to-torque curve (moment of inertia $J=0.095$)

Task2

1. No-load test:0



Calculation:

$$I_n := 1.83$$

$$P_n := 5.934$$

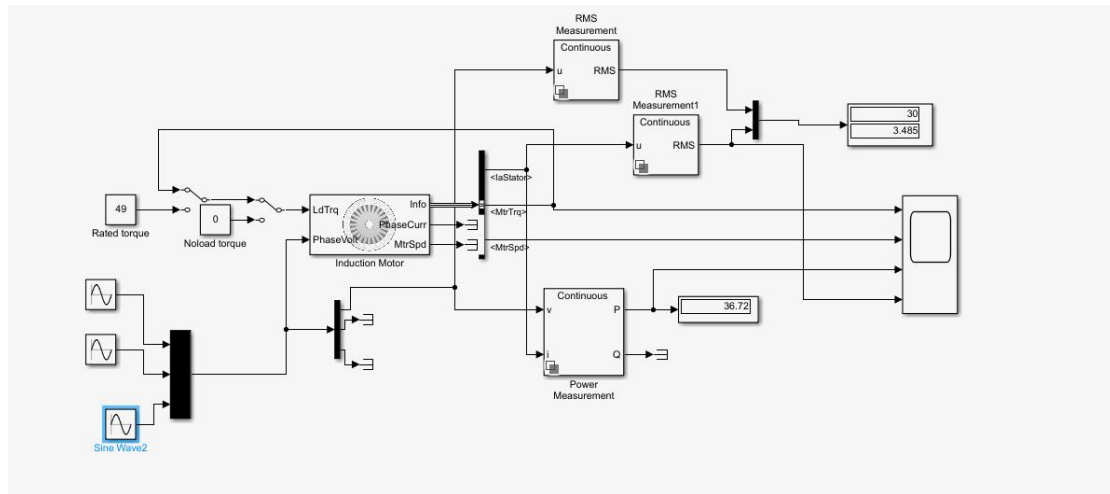
$$U_n := 220$$

$$Z_n := \frac{U_n}{I_n} = 120.2186$$

$$R_s := \frac{P_n}{I_n^2} = 1.7719$$

$$X_n := \sqrt{Z_n^2 - R_s^2} = 120.2055$$

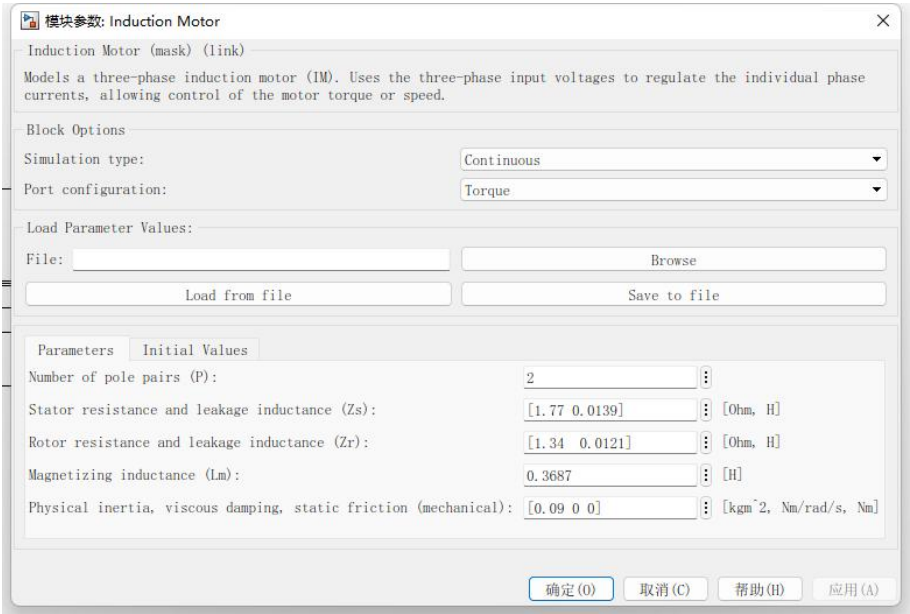
2. Blocked rotor test



Calculation:

$$\begin{aligned}
 I_b &:= 3.484 \\
 U_b &:= 30 \\
 P_b &:= 36.73 \\
 R_r &:= \frac{P_b}{I_b^2} - R_s = 1.254 \\
 Z_b &:= \frac{U_b}{I_b} = 8.6108 \\
 X_b &:= \sqrt{Z_b^2 - (R_s + R_r)^2} = 8.0616 \\
 X_{ls} &:= 0.5 \cdot X_b = 4.0308 \\
 X_{lr} &:= 0.5 \cdot X_b = 4.0308 \\
 X_m &:= X_n - X_{ls} = 116.1747 \\
 L_{ls} &:= \frac{X_{ls}}{2 \cdot \pi \cdot 50} = 0.0128 \\
 L_{lr} &:= \frac{X_{lr}}{2 \cdot \pi \cdot 50} = 0.0128 \\
 L_m &:= \frac{X_m}{2 \cdot \pi \cdot 50} = 0.3698
 \end{aligned}$$

3. Block Induction Motor



4.Conclusion:

The task involved evaluating the performance of an induction motor through simulation. By applying load torque and phase voltage, the model produced outputs like phase current and motor speed, enabling comparison between loaded and no-load states. RMS measurement blocks provided data on input voltage and current stability, while the power measurement block allowed for analyzing real and reactive power, helping to calculate motor efficiency and power factor. The system's display monitored key parameters, facilitating the assessment of the motor's performance against design goals.

Part3:

模块参数: Asynchronous Machine SI Units

Asynchronous Machine (mask) (link)

Implements a three-phase asynchronous machine (wound rotor, squirrel cage or double squirrel cage) modeled in a selectable dq reference frame (rotor, stator, or synchronous). Stator and rotor windings are connected in wye to an internal neutral point.

ConfigurationParametersLoad Flow

Rotor type: Squirrel-cage

Preset parameters

Squirrel-cage preset model: No

Double squirrel-cage preset model: Open parameter estimator

Mechanical input: Torque Tm

Reference frame: Stationary

Measurement output

☐ Use signal names to identify bus labels

确定(O)取消(C)帮助(H)应用(A)

Parameters of Asynchronous Machine SI Units

模块参数: Induction Motor

Induction Motor (mask) (link)

Models a three-phase induction motor (IM). Uses the three-phase input voltages to regulate the individual phase currents, allowing control of the motor torque or speed.

Block Options

Simulation type: Continuous

Port configuration: Torque

Load Parameter Values:

File: Browse

Load from fileSave to file

ParametersInitial Values

Number of pole pairs (P):2

Stator resistance and leakage inductance (Zs):[1.77 0.0139][Ohm, H]

Rotor resistance and leakage inductance (Zr):[1.34 0.0121][Ohm, H]

Magnetizing inductance (Lm):0.3687[H]

Physical inertia, viscous damping, static friction (mechanical):[0.09 0 0][kgm^2, Nm/rad/s, Nm]

确定(O)取消(C)帮助(H)应用(A)

Parameters of Induction Motor (J=0.09)

模块参数: Induction Motor2

Induction Motor (mask) (link)

Models a three-phase induction motor (IM). Uses the three-phase input voltages to regulate the individual phase currents, allowing control of the motor torque or speed.

Block Options

Simulation type: Continuous
Port configuration: Torque

Load Parameter Values:

File: Browse

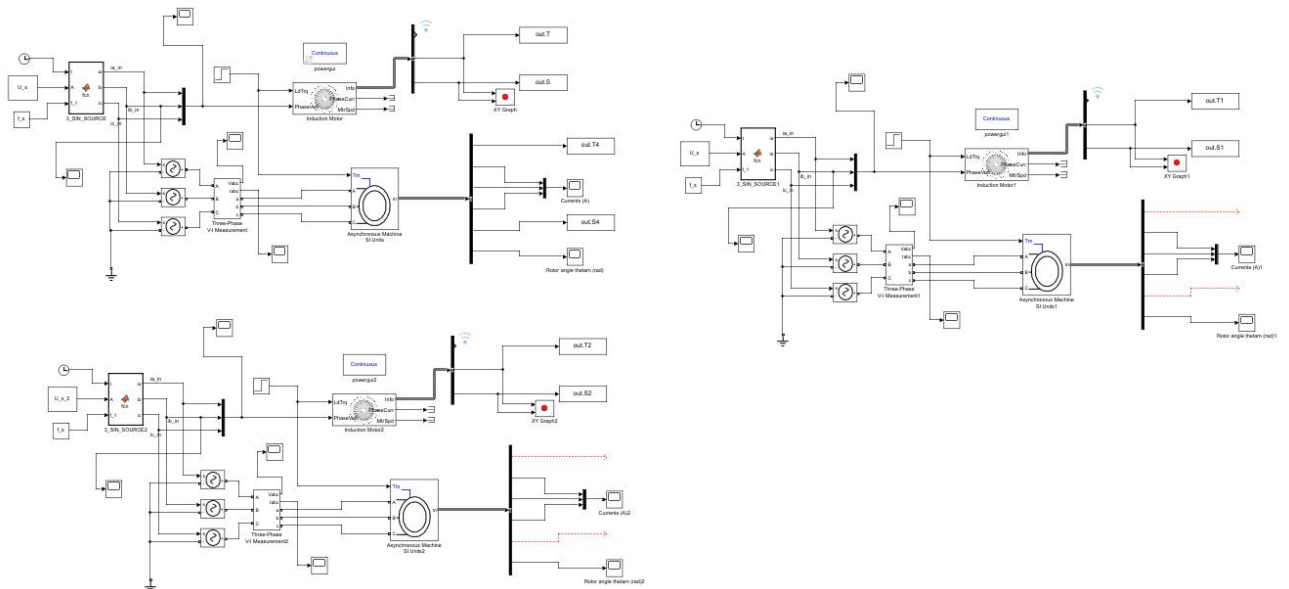
Load from file Save to file

Parameters Initial Values

Number of pole pairs (P): 2
Stator resistance and leakage inductance (Zs): [1.77 0.0139] [Ohm, H]
Rotor resistance and leakage inductance (Zr): [Rr_1 0.0121] [Ohm, H]
Magnetizing inductance (Lm): 0.3687 [H]
Physical inertia, viscous damping, static friction (mechanical): [0.095 0 0] [kgm², Nm/rad/s, Nm]

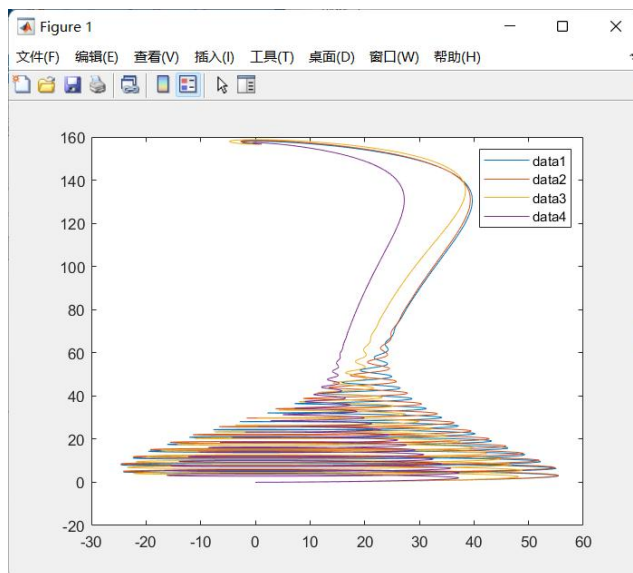
确定(O) 取消(C) 帮助(H) 应用(A)

Parameters of Induction Motor (Rr=1.50)



```
U_s = 220*sqrt(2);  
f_s = 50;  
Rr_1 = 1.50;  
U_s_2 = 150*sqrt(2);
```

```
plot(out.T,out.S,out.T4,out.S4,out.T1,out.S1,out.T2,out.S2)  
legend;
```



Conclusion:

I learned how to evaluate the performance of an induction motor by conducting a no-load test and a blocked rotor test using a Simulink model. These tests allowed me to determine key parameters for the motor's equivalent circuit, such as stator resistance and reactance. By analyzing the motor's dynamic behavior, I was able to compare it with its design specifications and assess its efficiency under different conditions.