Servo Lab

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ITMO ID:375334
HDU ID:22320404

1. Data

HDU number	Name	U_dc, V	Ke, V*s/rad	R	L	T_rated, Nm	Speed_rated, rev/min	J_motor, kg*m^2
22320404	LI XIN	750	0.3255	0.044	0.000748	277.5	19800	0.230000

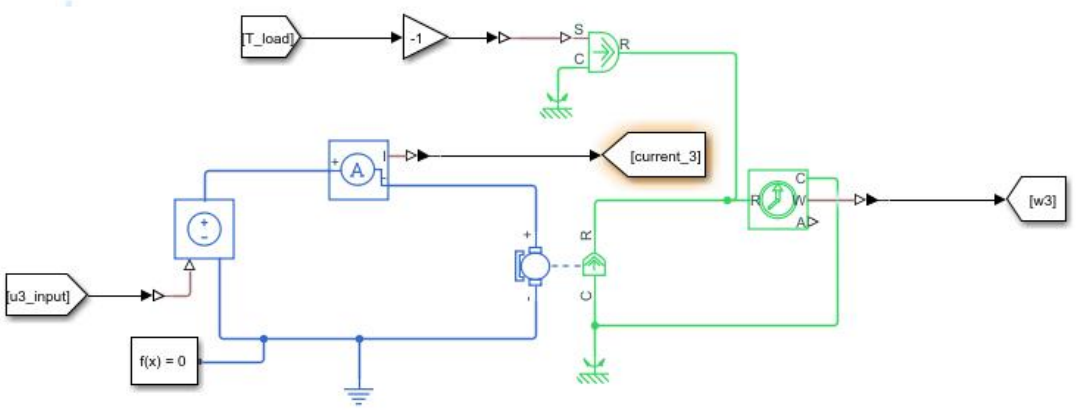
2. Code

```
V_rated = 750; % V
Ra = 0.044;% Ohm
La = 0.000748; % H
Ke = 0.3255; % V*s /rad
Kt = Ke; % torque constant
T_rated = 277.5; % Nm
J = 0.230000; % kg*m^2
n_rated = 19800; % rev/ min

%% calculate the controller parameters
Ta = La/Ra; % electrical time constant
Tm = J*Ra/ (Kt*Ke); % mechanical time constant
Kob = V_rated/Ke; % static gain
Kp = Tm/(2*Ta*Kob); % proportional coefficient
```

J	0.2300
Ke	0.3255
Kob	2.3041e+03
Kp	0.0012
Kt	0.3255
La	7.4800e-04
n_rated	19800
Ra	0.0440
T_rated	277.5000
Ta	0.0170
Ti	0.0955
Tm	0.0955
V_rated	750

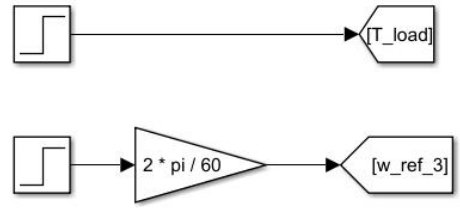
3. Simscape model

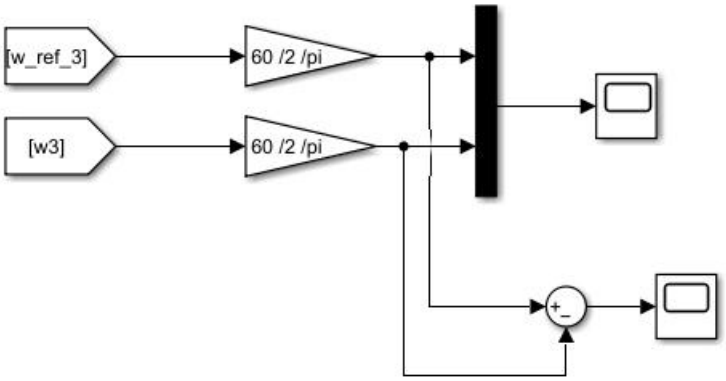


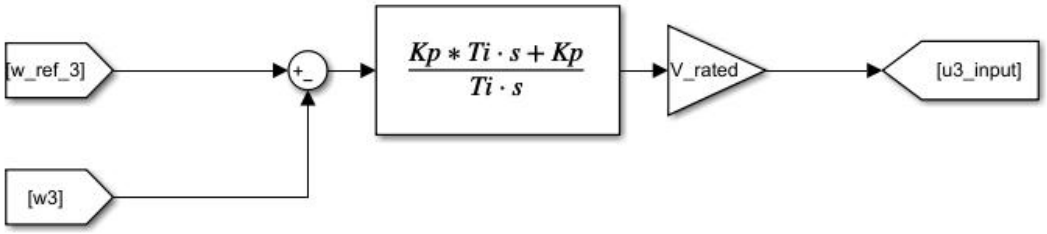
4. Results of Tm and Ta

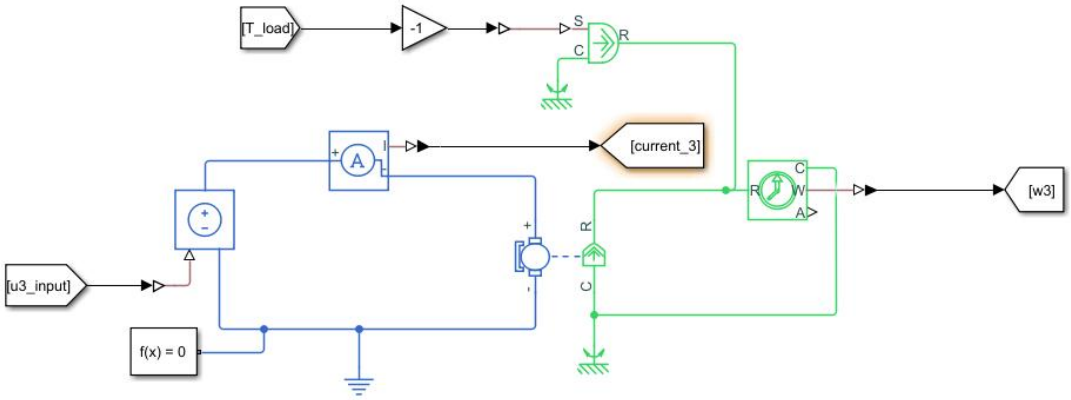
Tm=0.0955 Ta=0.0170

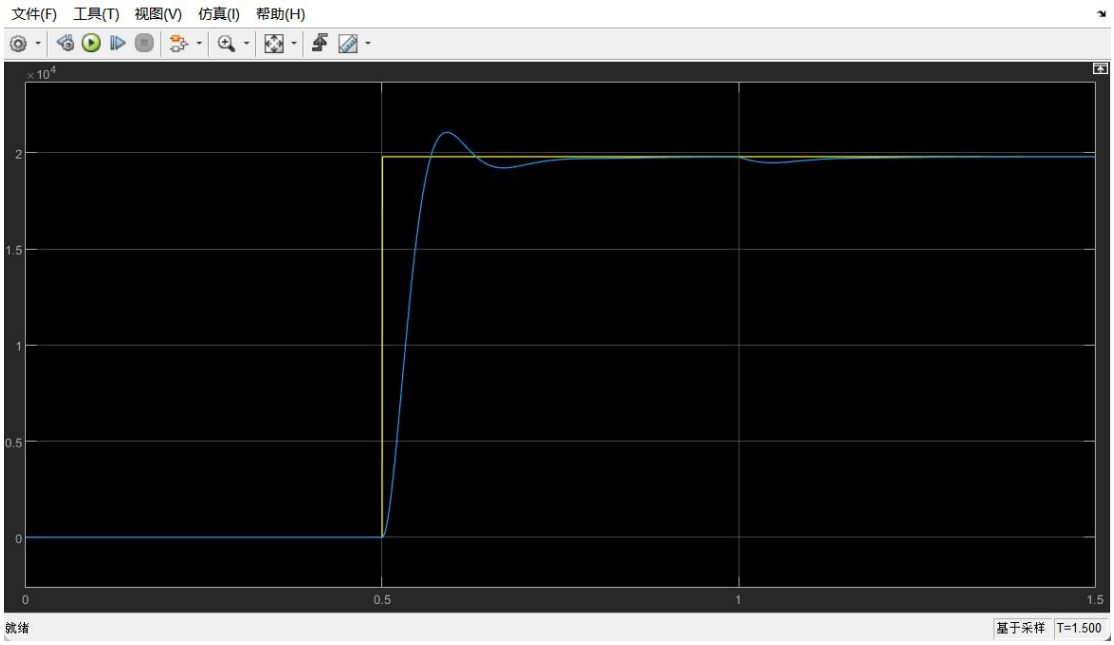
5. Simulation 1

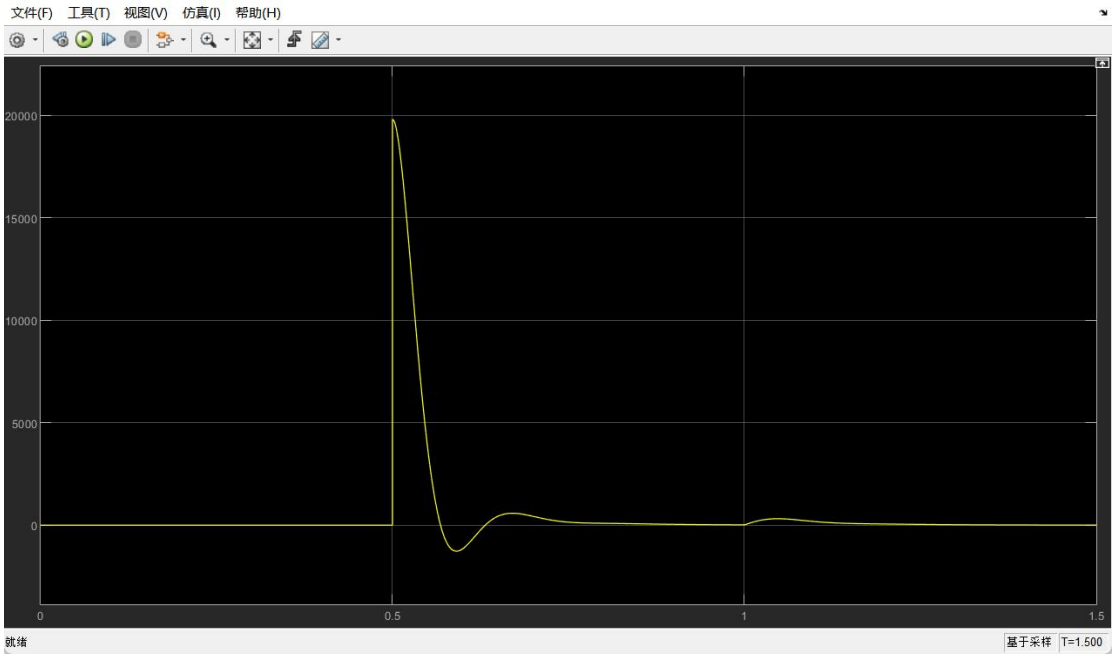




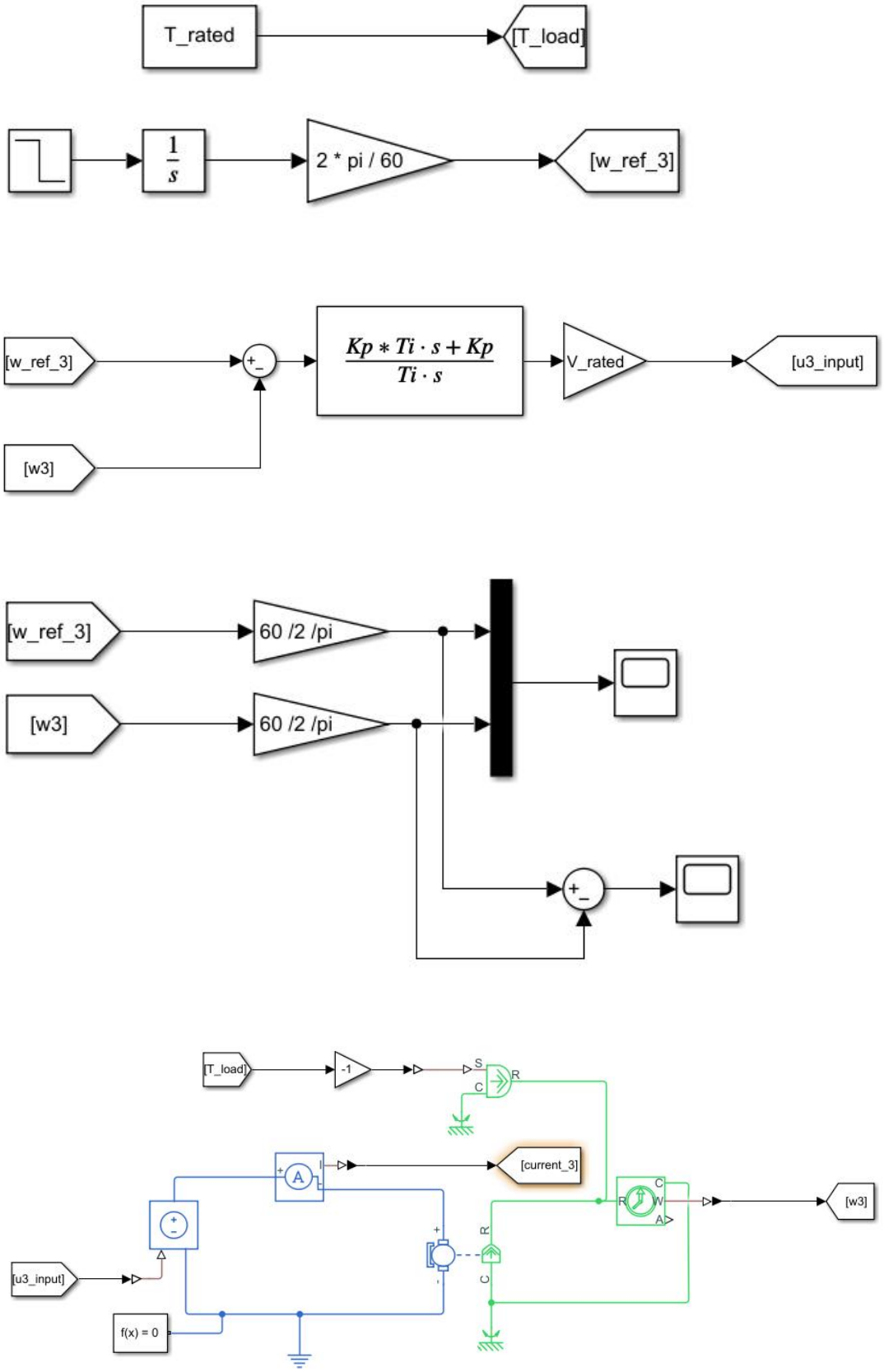


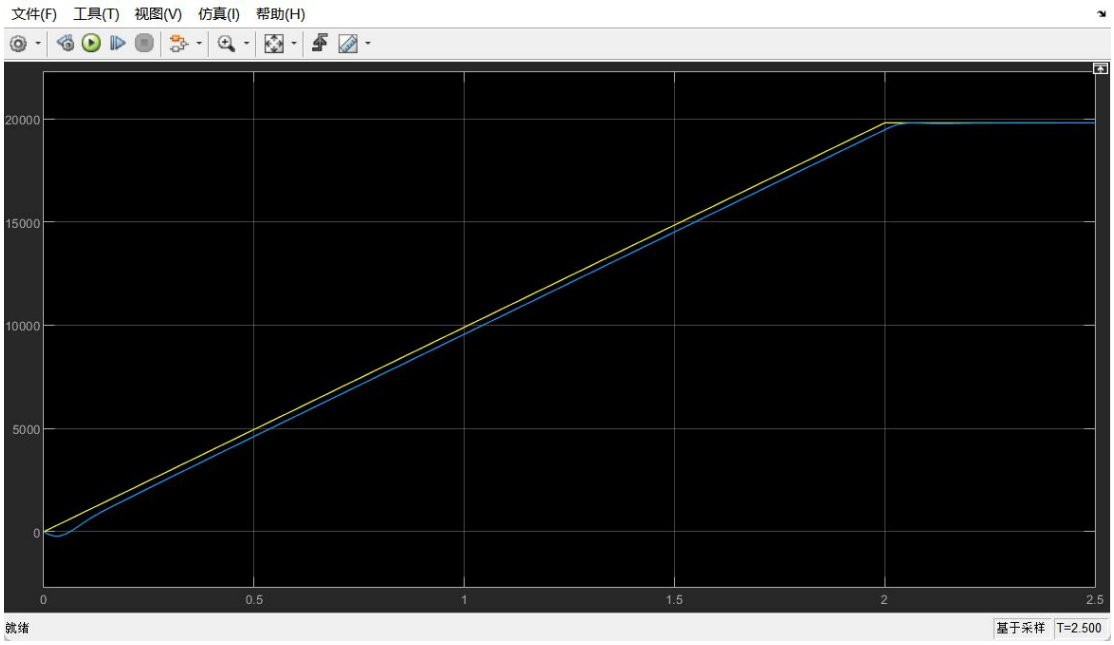


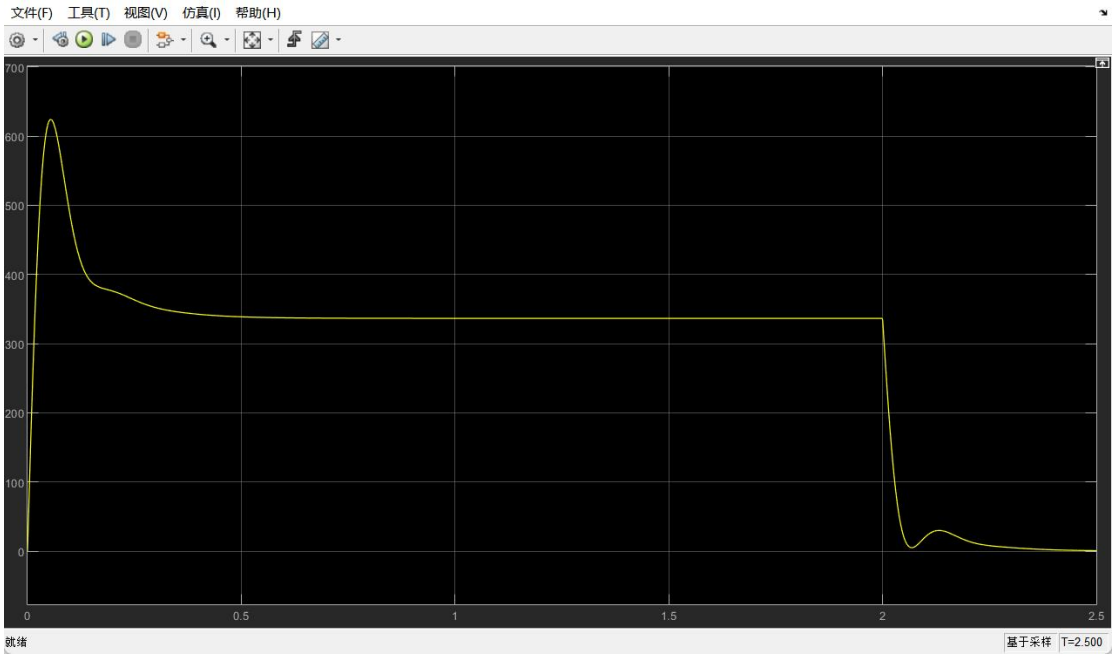

文件(F) 工具(T) 视图(V) 仿真(I) 帮助(H)
×10^4
2
1.5
1
0.5
0
0
0.5
1
1.5
就绪
基于采样
T=1.500


文件(F) 工具(T) 视图(V) 仿真(I) 帮助(H)
20000
15000
10000
5000
0
0
0.5
1
1.5
就绪
基于采样
T=1.500

6. Simulation 2




文件(F) 工具(T) 视图(V) 仿真(I) 帮助(H)
20000
15000
10000
5000
0
0
0.5
1
1.5
2
2.5
就绪
基于采样
T=2.500


文件(F) 工具(T) 视图(V) 仿真(I) 帮助(H)
700
600
500
400
300
200
100
0
0
0.5
1
1.5
2
2.5
就绪
基于采样
T=2.500

7.Conclusion

In Simulation 1, where a constant reference speed signal was applied, the servo motor swiftly achieved the set speed with a negligible steady-state error. This demonstrated the system's capability to maintain a stable output under constant conditions, exhibiting **Type 0** performance characteristics. The system's output behavior in this scenario was akin to that of a zero-order system, where it reached equilibrium and then maintained a constant output value with a persistent error signal.

Simulation 2 involved a constant rate of change in the reference speed. In this case, the system was able to maintain a stable output and an error signal approaching zero under steady-state conditions, despite a continuous tracking error while following the changing reference value. This scenario highlighted the system's good adaptability to changing inputs. Although there was a brief drop in speed when the load increased, the system generally tracked the changes in reference speed effectively. The system exhibited **Type 1** performance characteristics, showing rapid response and adaptability to input changes.

Overall, the servo motor demonstrated high response speed and good stability in both simulations. In Simulation 1, the system's output was constant with a steady-state error, while in Simulation 2, it showed a tracking error due to the constant reference rate change. The slight error deviation observed in Simulation 2 could be due to inherent limitations of

the model. The initial rapid transient phase in both simulations was followed by a swift convergence of the error to a stable state, indicating the system's exceptional level of stability and responsiveness.