



İSTANBUL TECHNICAL UNIVERSITY

Faculty of Aeronautics and Astronautics

SPACECRAFT CONTROL SYSTEMS

HOMEWORK #2

HOMEWORK #2 REPORT

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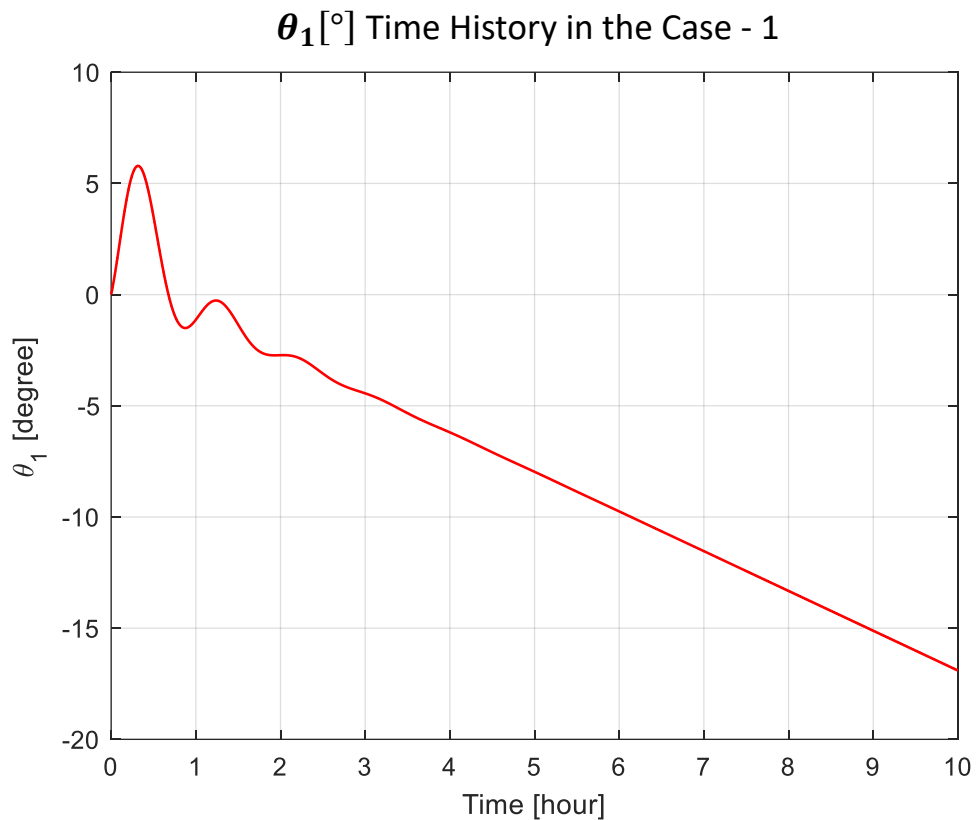
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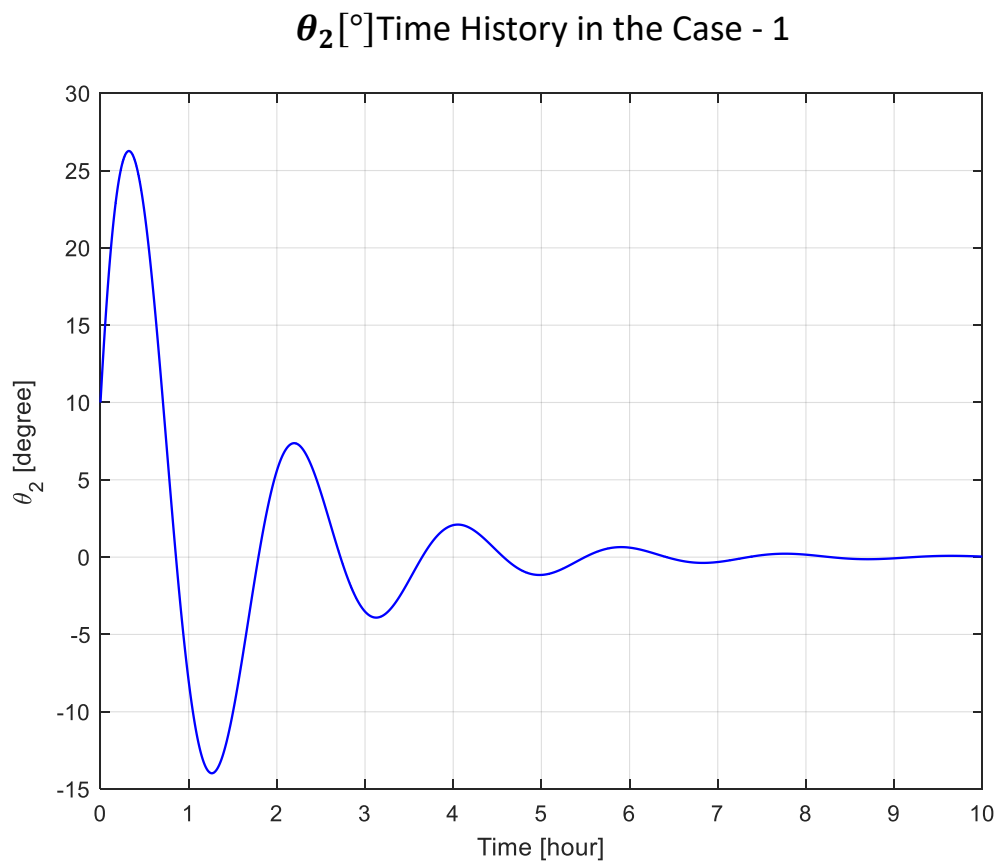
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PLOTS FOR THE CASE – 1

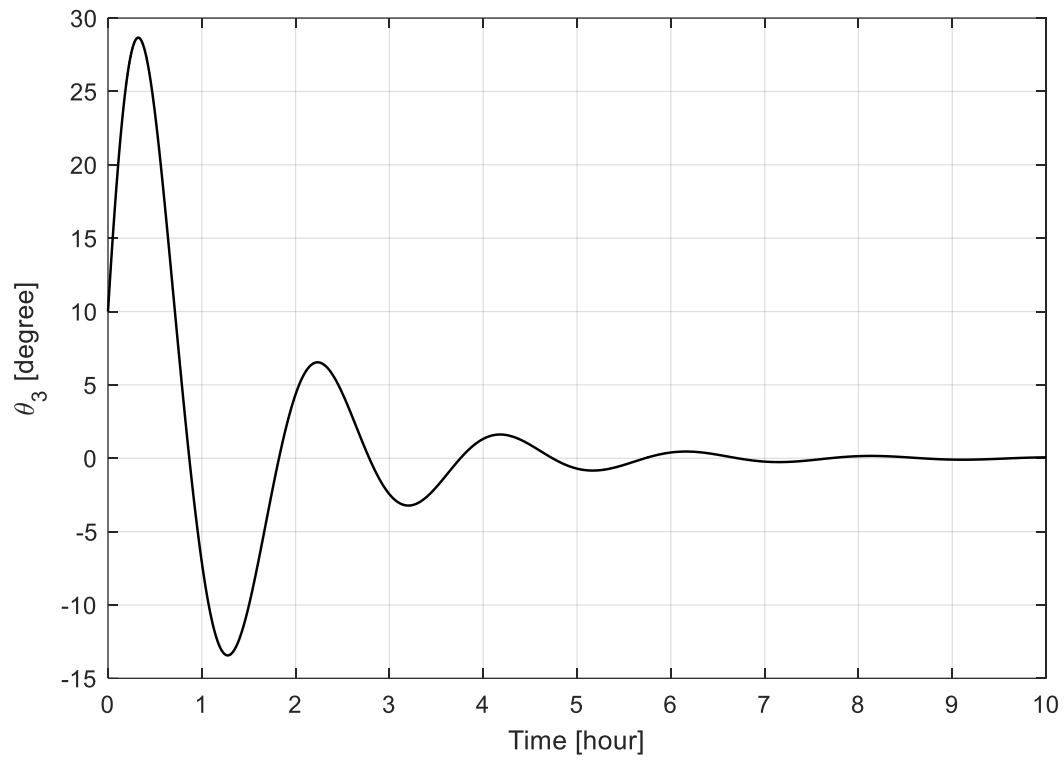
Time History of the Attitude Angles



Note : It can not expected θ_1 to approximate to a value because, controller torque has not been generated for it due to utilized control method.

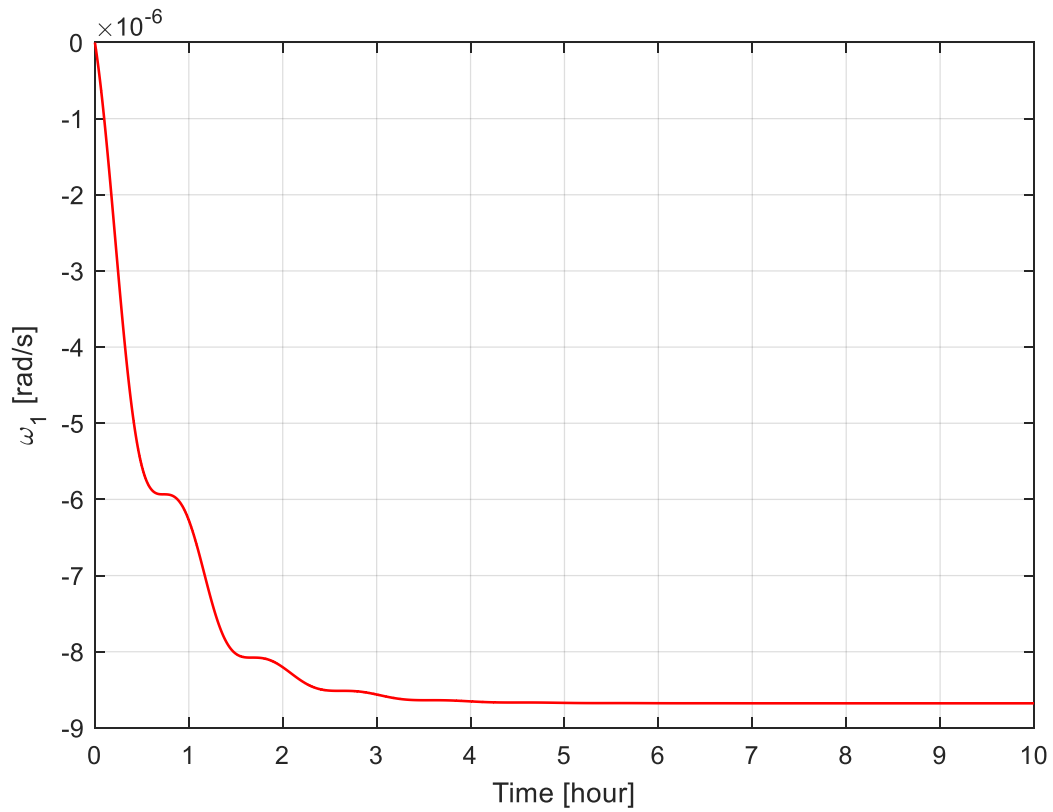


$\theta_3 [^\circ]$ Time History in the Case - 1

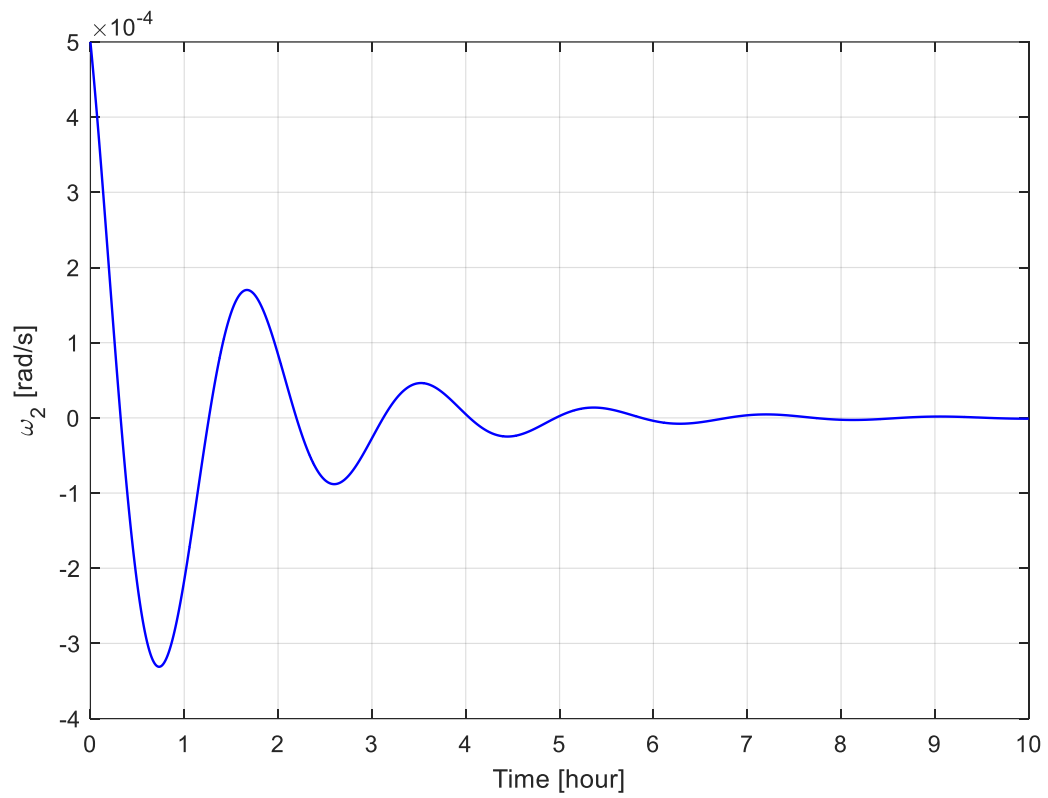


Time History of Angular Velocities

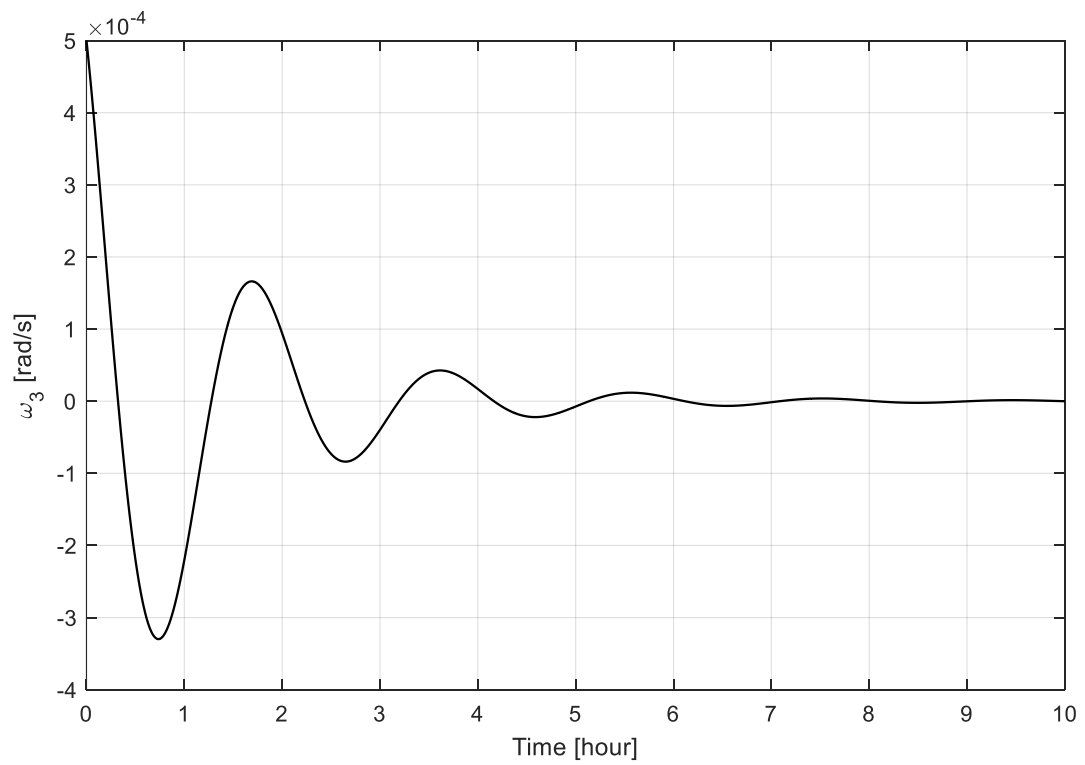
$\omega_1 \left[\frac{rad}{s} \right]$ Time History in the Case - 1



$\omega_2 \left[\frac{rad}{s} \right]$ Time History in the Case - 1

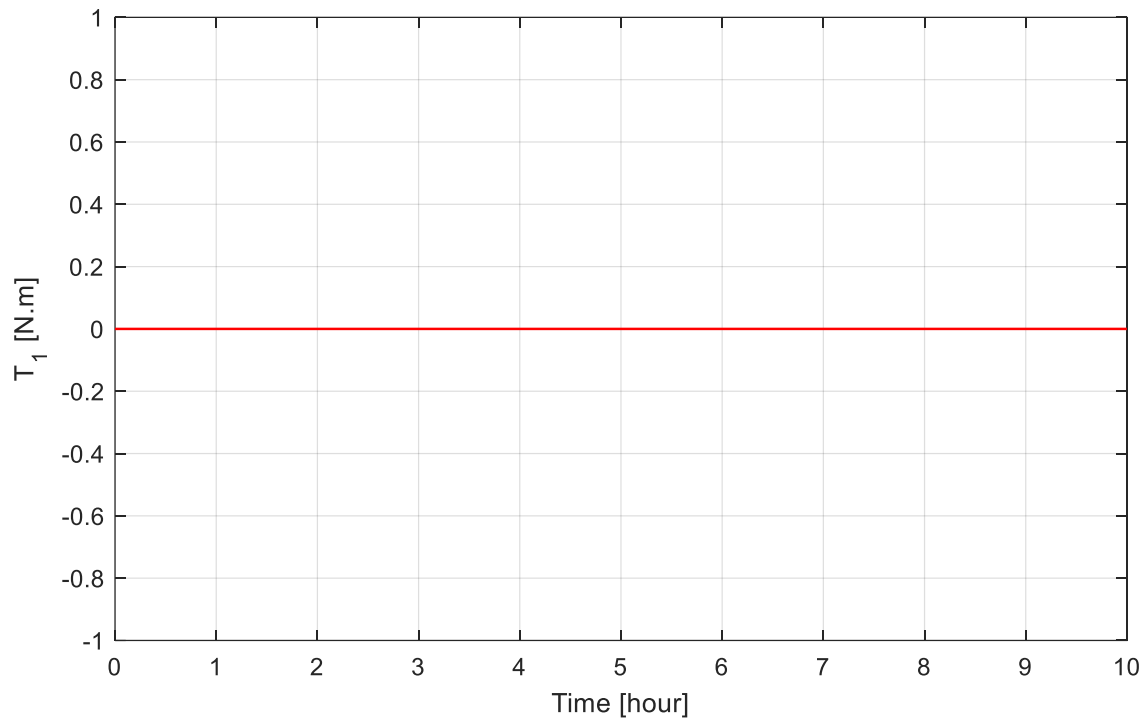


$\omega_3 \left[\frac{rad}{s} \right]$ Time History in the Case - 1

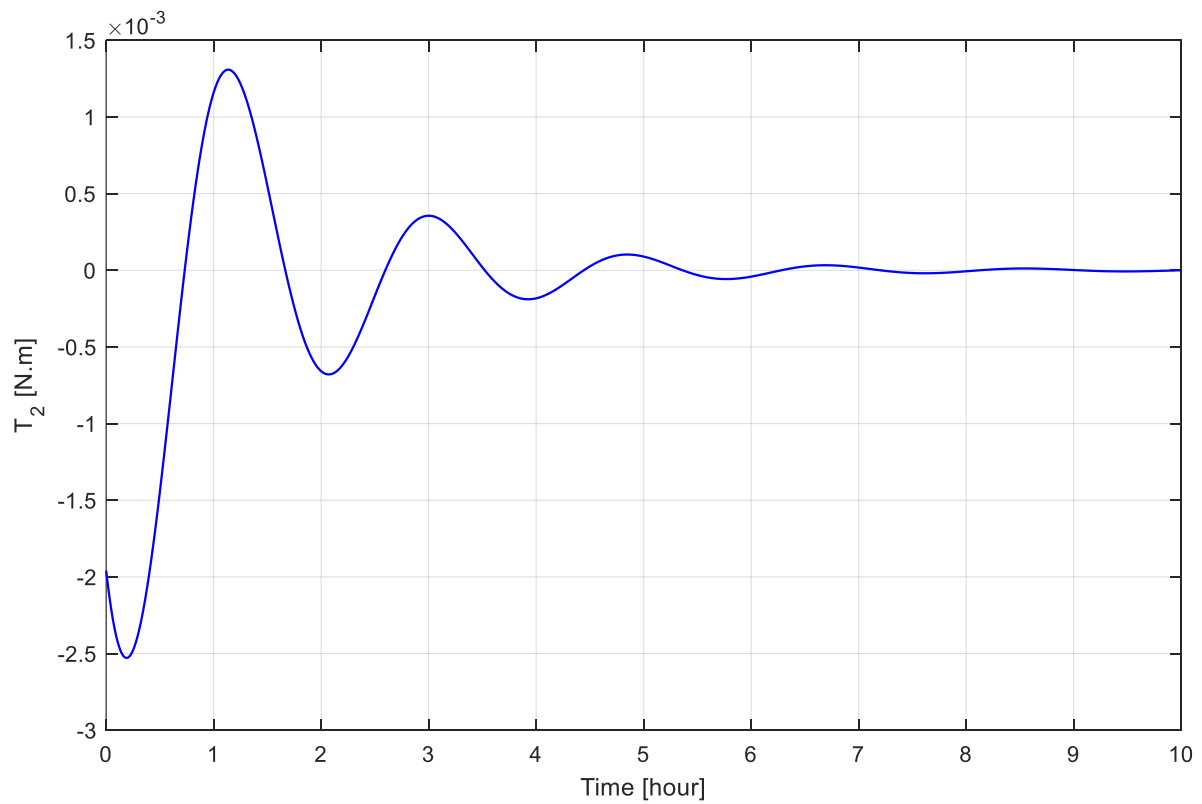


Time History of Control Torque Components

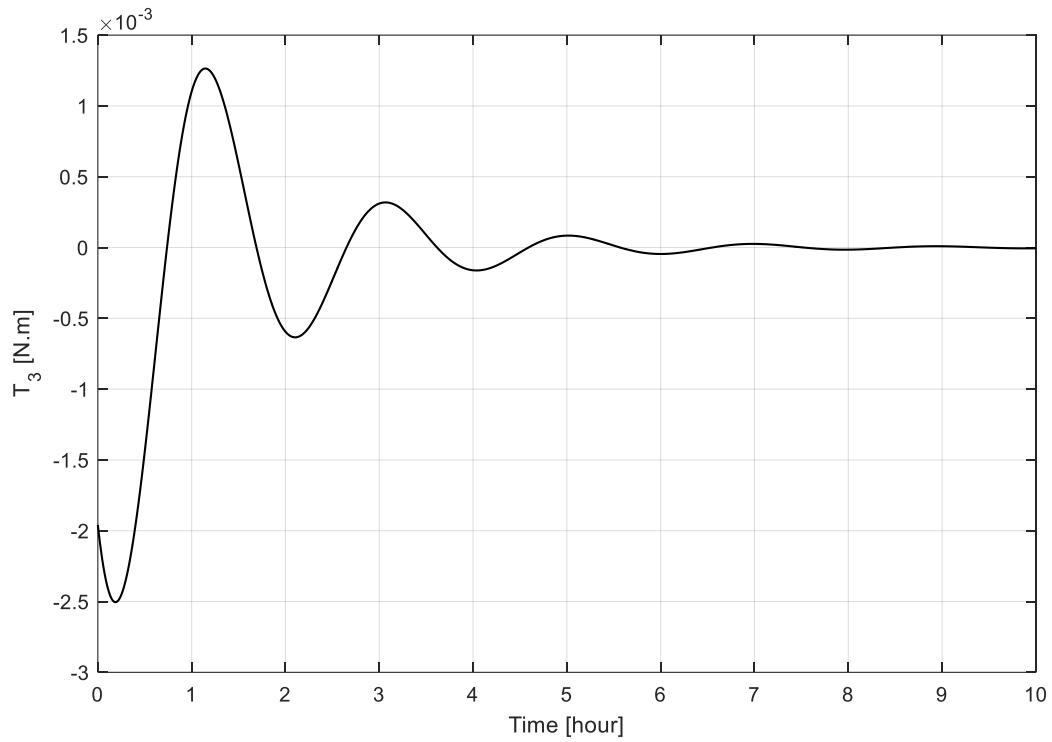
$T_1[N.m]$ Time History in the Case – 1



$T_2[N.m]$ Time History in the Case – 1



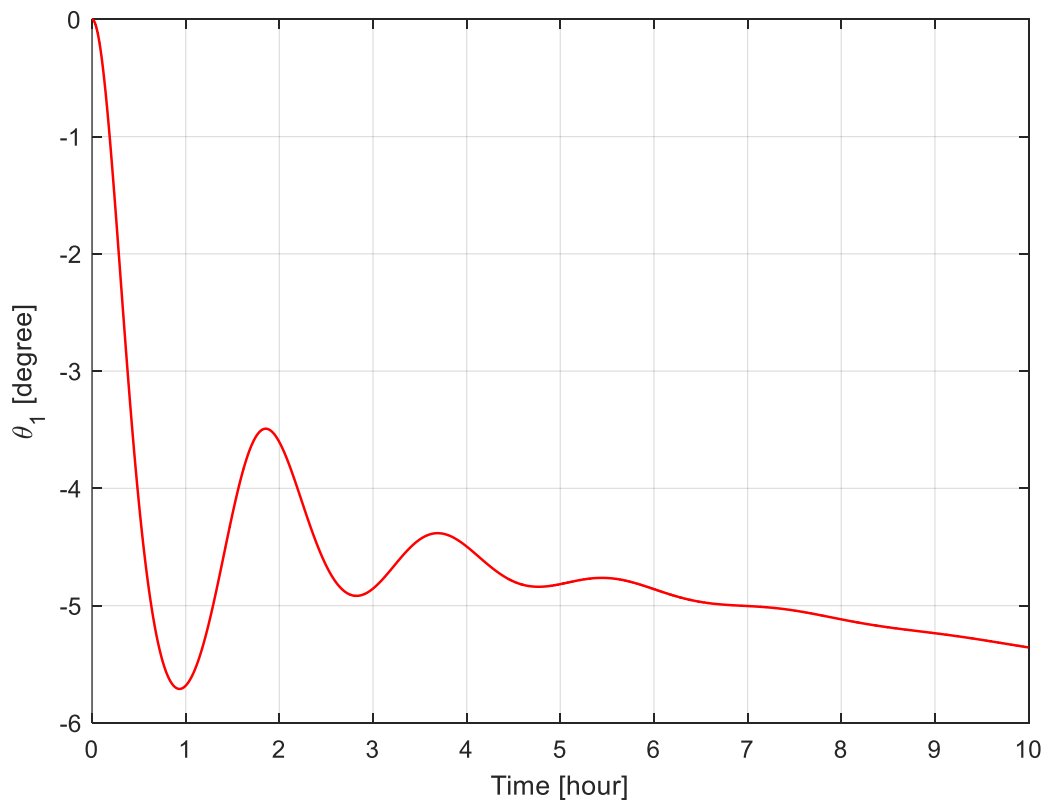
$T_3[N.m]$ Time History in the Case - 1



PLOTS FOR THE CASE – 2

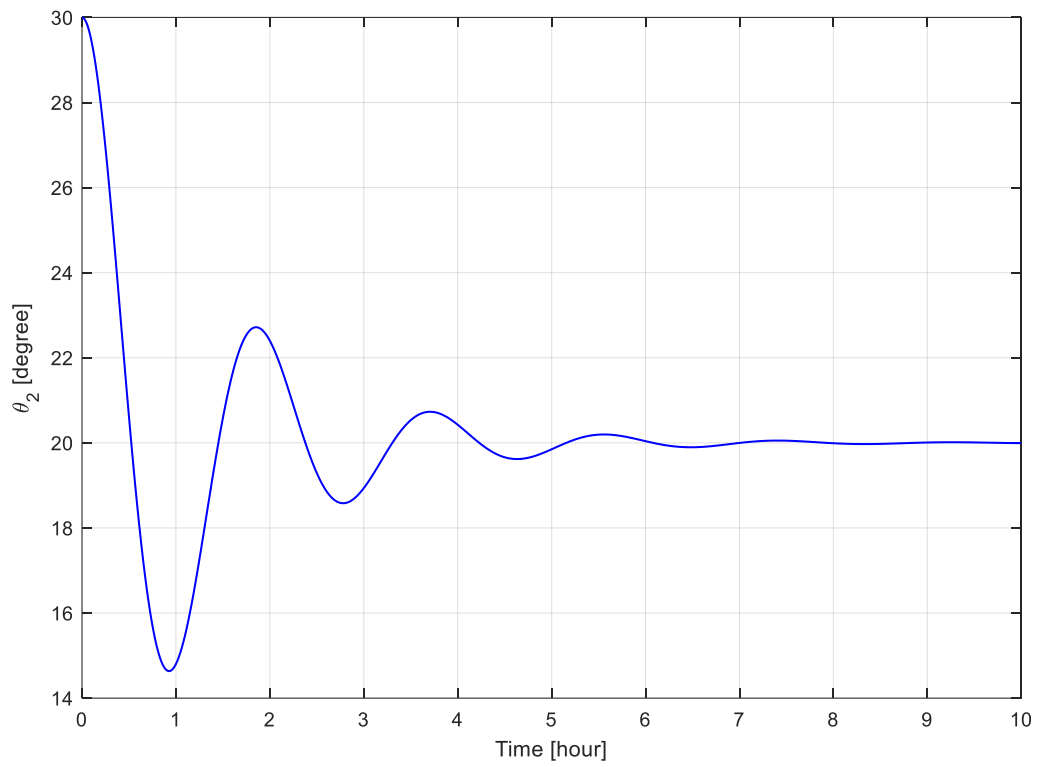
Attitude Angles

$\theta_1[^\circ]$ Time History in the Case - 2

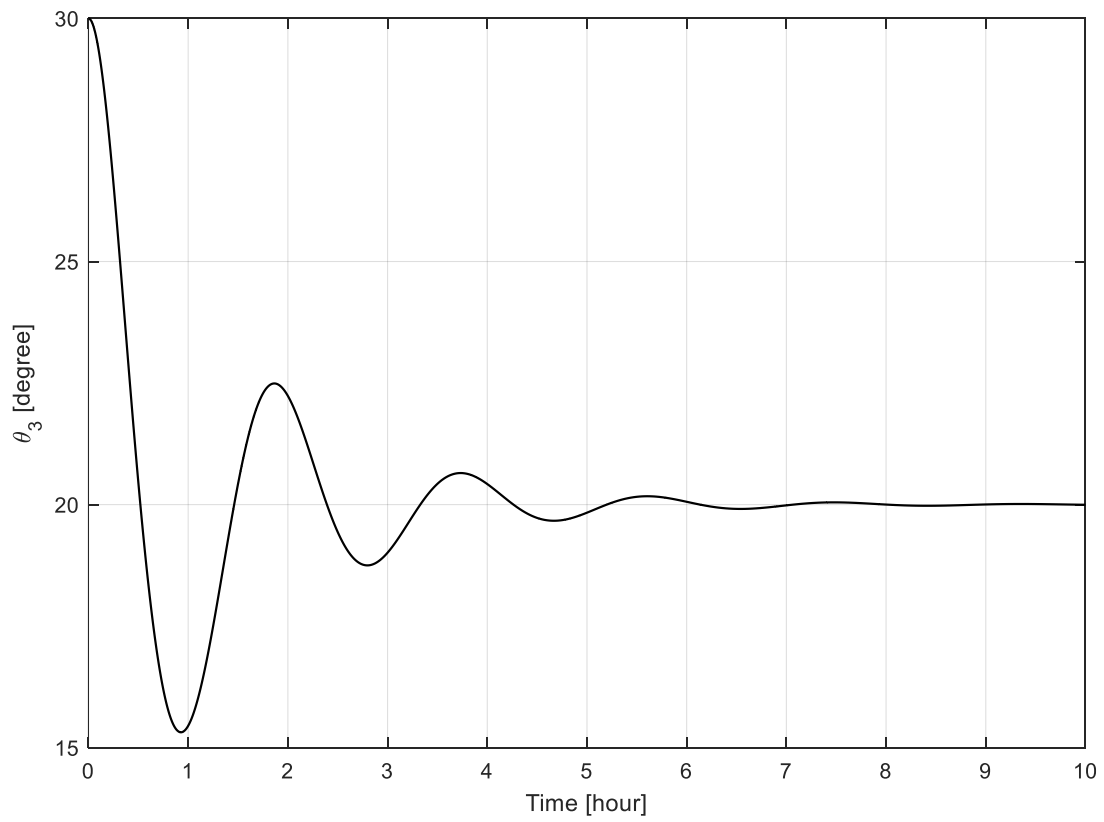


Note: This axis has not been controlled like in the Case – 1 but it seems like that it is approximating to -5° because of the impact of other torques.

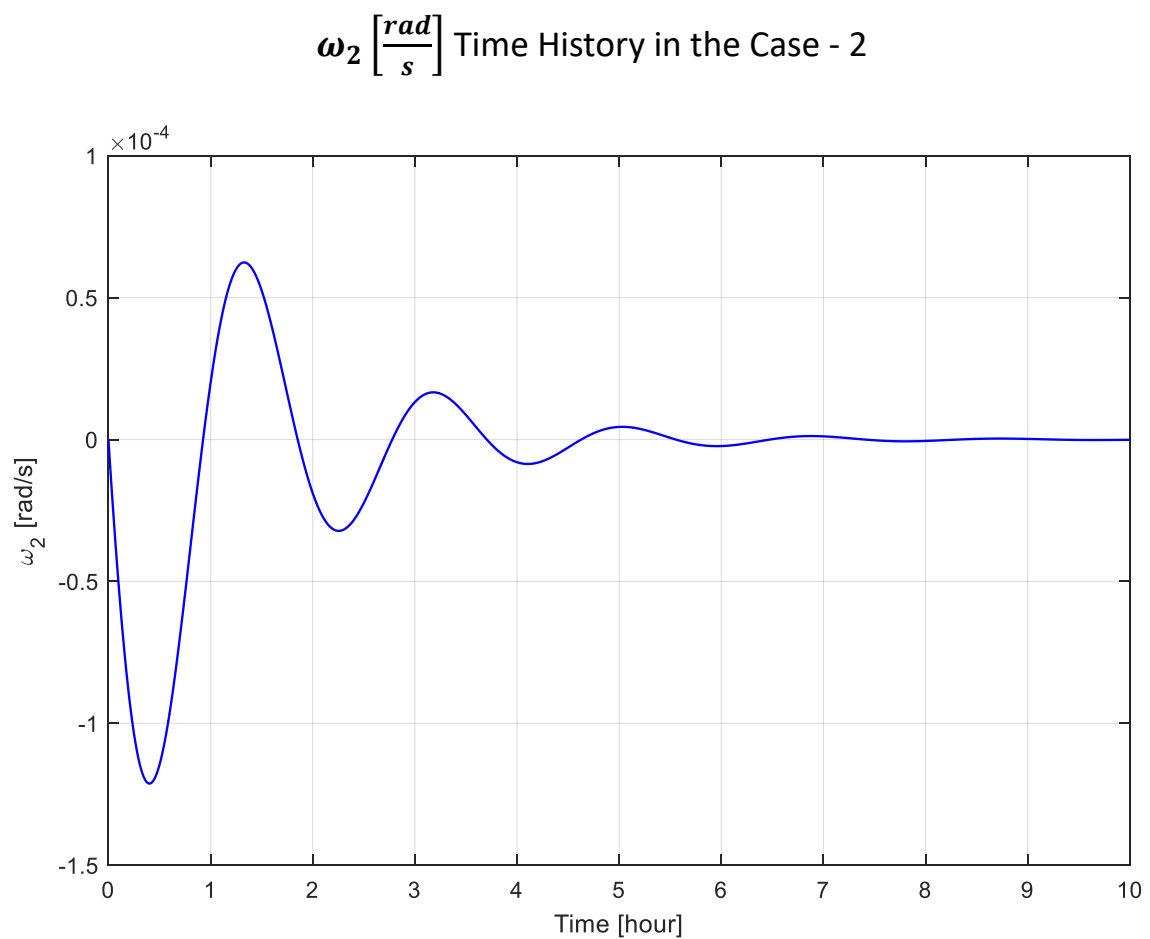
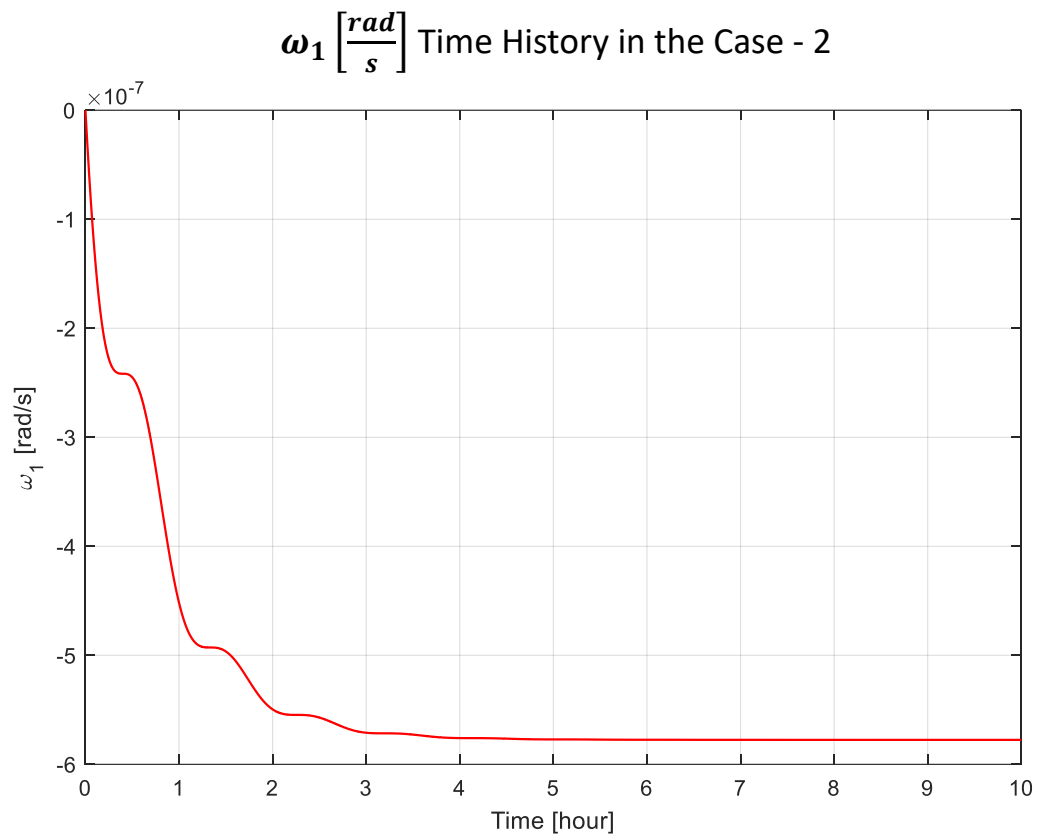
θ_2 [°] Time History in the Case - 2

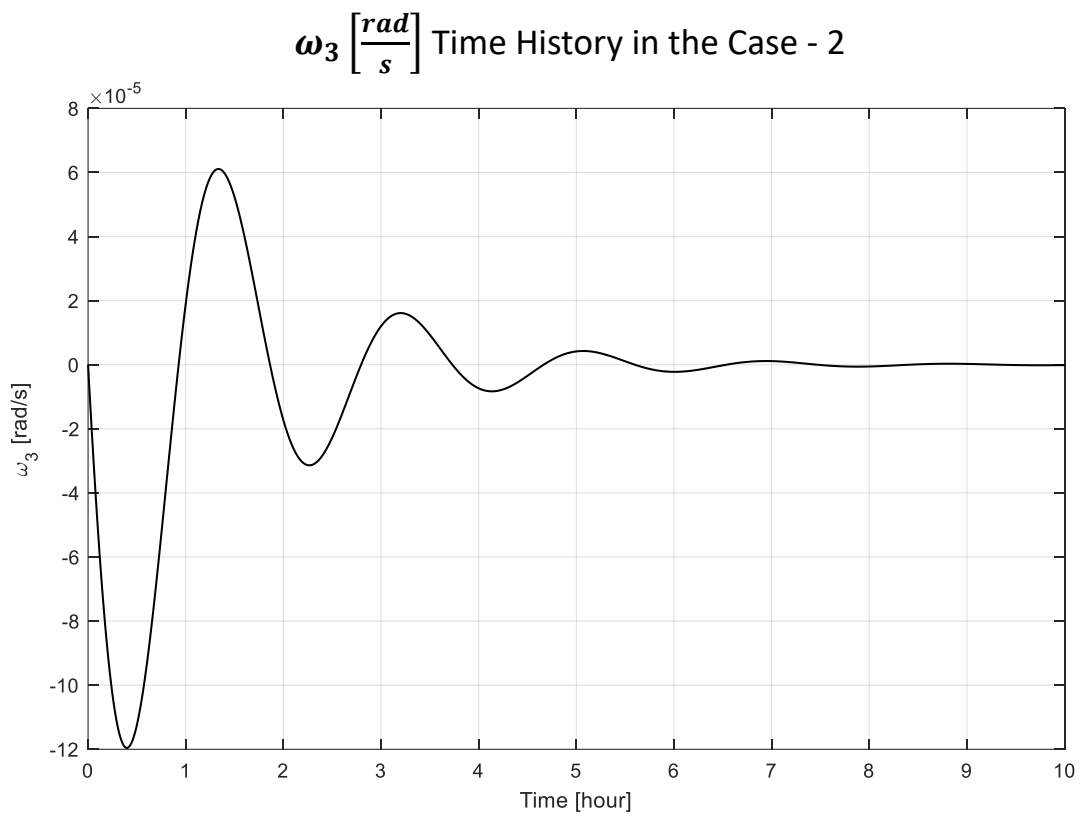


θ_3 [°] Time History in the Case - 2



Time History of Angular Velocities

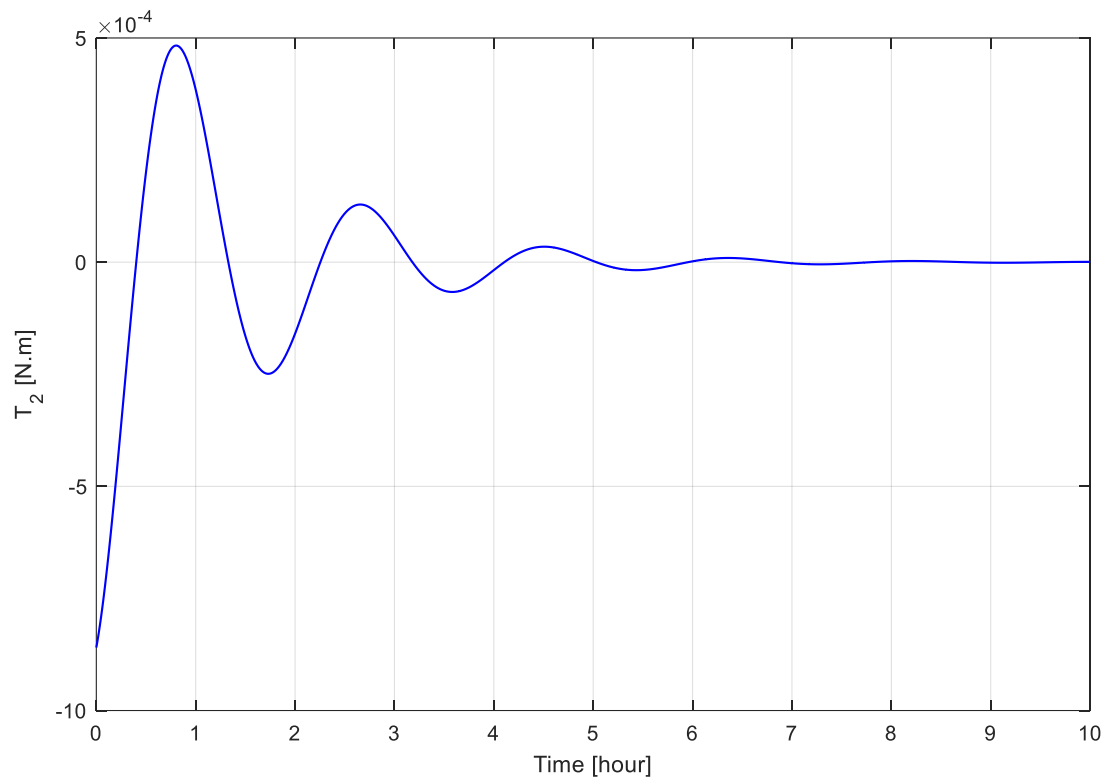




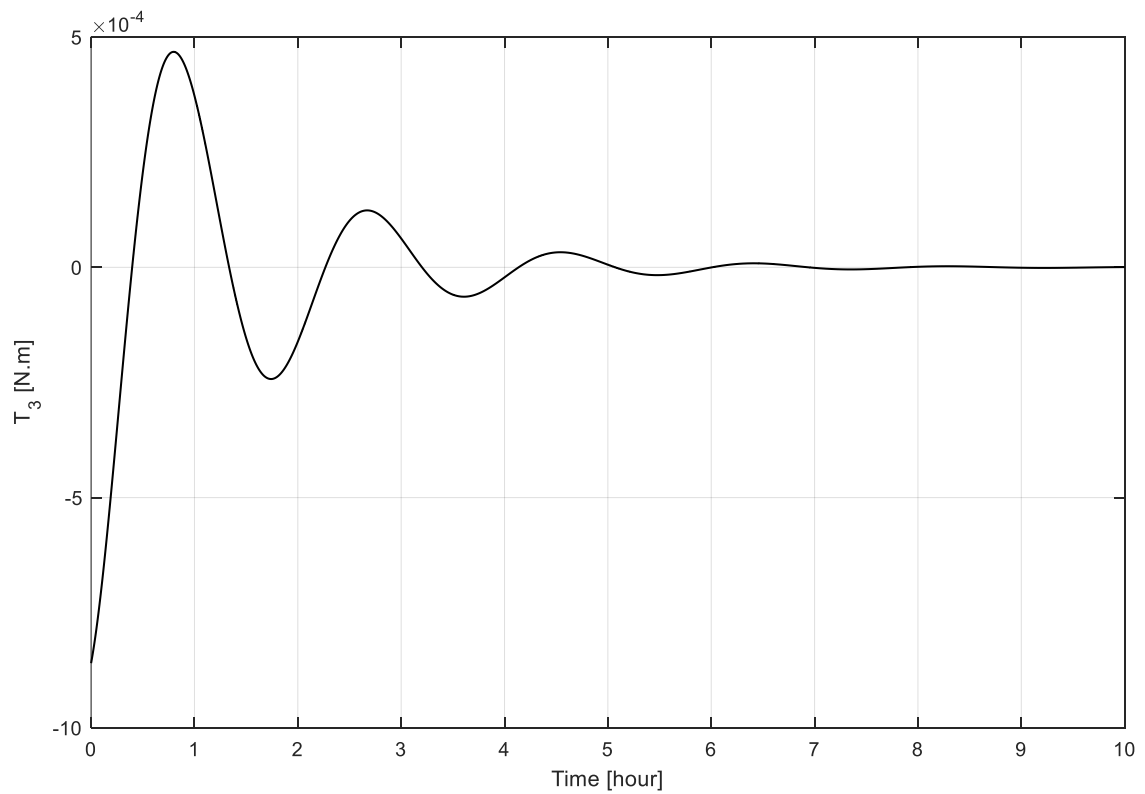
Time History of Control Torque Components



$T_2[N.m]$ Time History in the Case - 2



$T_3[N.m]$ Time History in the Case - 2



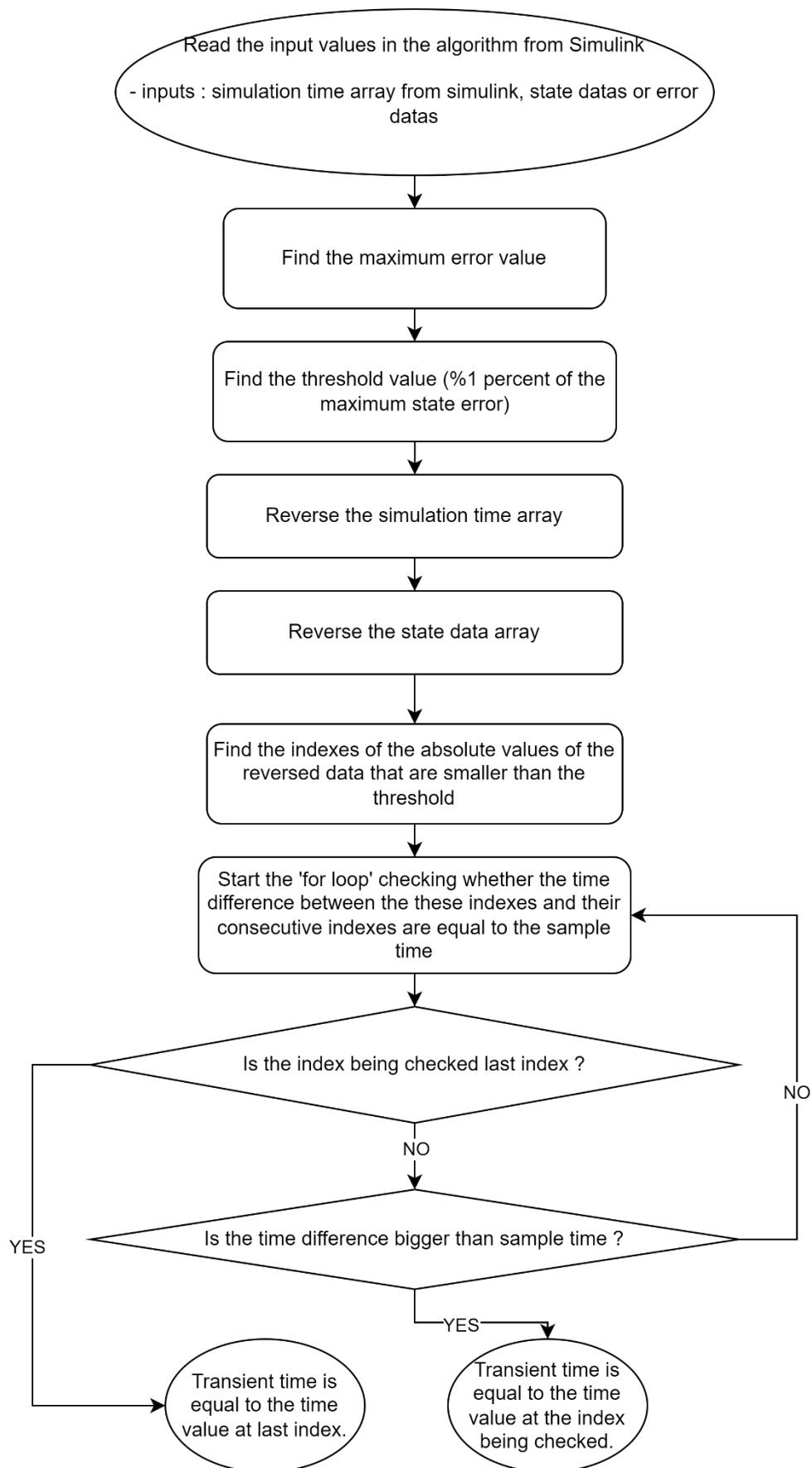
Transient Times Table of Angular Velocities for the Case- 1 and Case – 2

Angular Velocities $\left[\frac{rad}{s}\right]$	Case - 1	Case - 2
ω_1	No Controlled	No Controlled
ω_2	24799.5 seconds (6.88875 hours)	24799.5 seconds (6.88875 hours)
ω_3	22757.4 seconds (6.3215 hours)	22757.4 seconds (6.3215 hours)

Transient Times Table of Attitude Angles for the Case- 1 and Case – 2

Attitude Angles $[\circ]$	Case - 1	Case - 2
θ_1	No Controlled	No Controlled
θ_2	25464.7 seconds (7.0735277 hours)	23594.8 seconds (6.55411 hours)
θ_3	23233.9 seconds (6.4538611 hours)	21248.1 seconds (5.90225 hours)

The Algorithm Finding Transient Times



Conclusion

All the tasks assigned have been implemented successfully in Matlab/Simulink. Only one problem has been encountered when calculating the quaternion error using built-in block of Simulink. Although same block has been run to calculate attitude error in the Case-1, it didn't run correctly for the Case-2. Then the functions coded before have been used in place of built-in function to calculate the error of the attitude angles in the Case-2 through matlab function.

An interesting thing has been noticed in the results. It was seen that the transient times of the angular velocities for both cases were same however, it was noticed that it occurred because the sun vector in the body frame started with 45 degree in both case, the controller coefficients were same and the difference between desired attitude angle and initial attitude angle were same for both case so, it was considered that they could be same.