CHAPTER FOUR

SIMULATION RESULTS AND DISCUSSION

4.1 Introduction

This chapter shows the simulation results of the speed sensorless control of indirect vector controlled induction motor using RF-MRAS under different condition operations.

4.2 Simulation Results

In order to verify the effectiveness and feasibility of estimating rotor speed control of indirect vector controlled induction motor using RF-MRAS scheme for different speed commands, a simulation model has been developed in MATLAB/SIMULINK platform as shown in Figure 4.1.

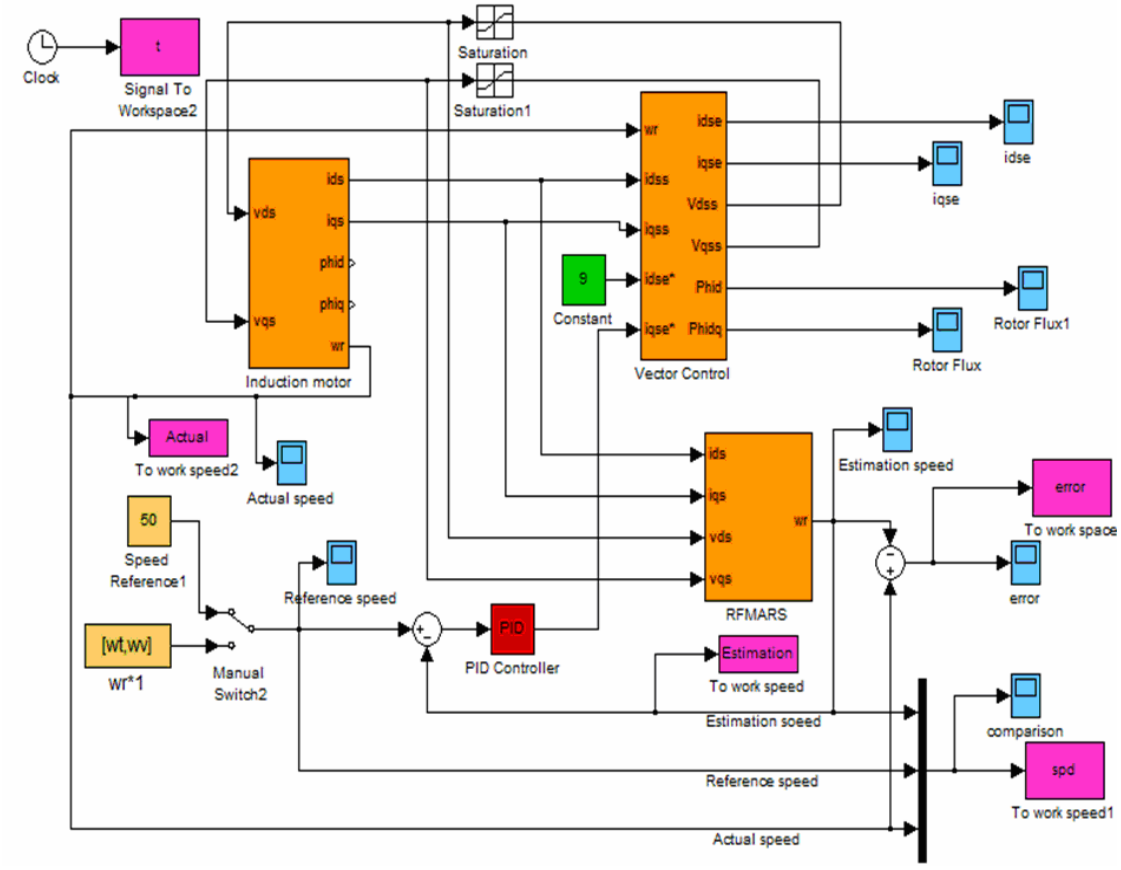

Figure 4.1: MATLAB/SIMULINK block diagram of sensorless speed control of indirect vector controlled induction motor using RF-MRAS

The parameters of the induction motor used for simulation procedure are listed in Table 4.1.

Table 4.1: Parameters of the induction motor

Parameters	Values
Rotor resistance, R_r	0.75 Ω
Stator resistance, R_s	0.55 Ω
Rotor inductance, L_r	0.068 H
Stator inductance, L_s	0.068 H
Magnetizing inductance, L_m	0.063 H
Moment of inertia, J	0.05 $kg.m^2$
Viscous friction coefficient, B	0.002 Nms^{-1}

4.2.1 Low constant speed command

In Figure 4.2 shows the behavior of induction motor speed estimation where the induction motor rotates at low constant speed (50rad/sec) at no-load.

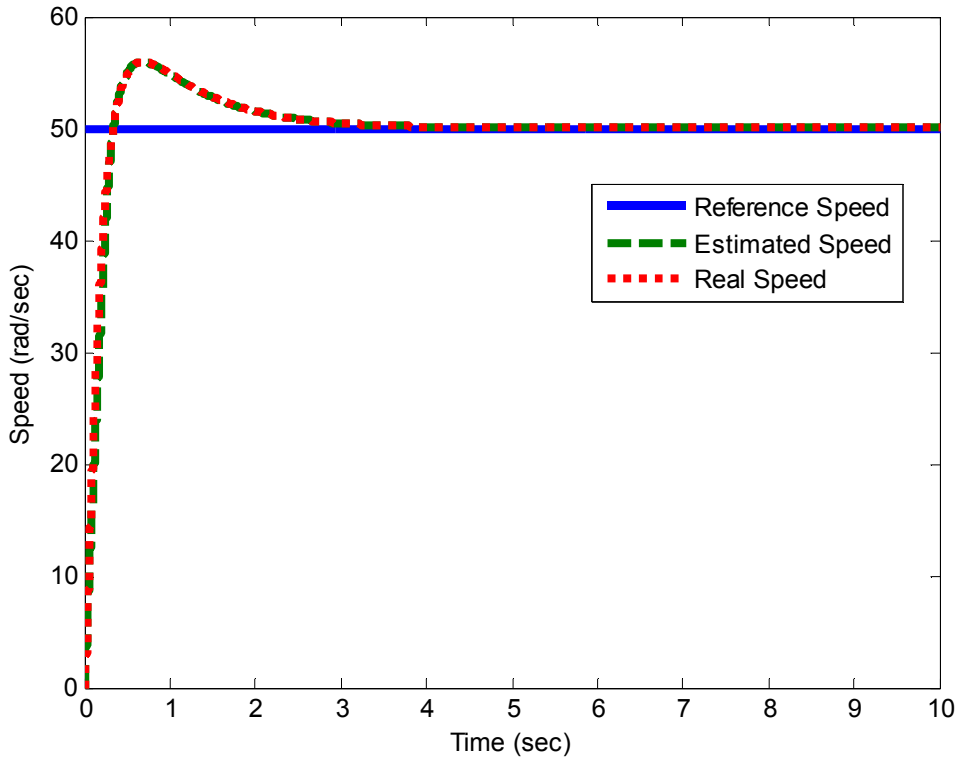

Figure 4.2: The real and estimated speeds at low constant speed

The simulation is performed for ten seconds. It is seen that the actual (real) and estimated speeds can track the trajectory of the reference speed very well with a little overshoot which is reasonable and no steady state error. The steady state was reached at 2.2 seconds. Figure 4.3 shows the speed error or estimated error (calculated from the difference between the real speed and the estimated speed). The peak speed error between estimated and actual speeds is within the range +5rad/sec and -1rad/sec.

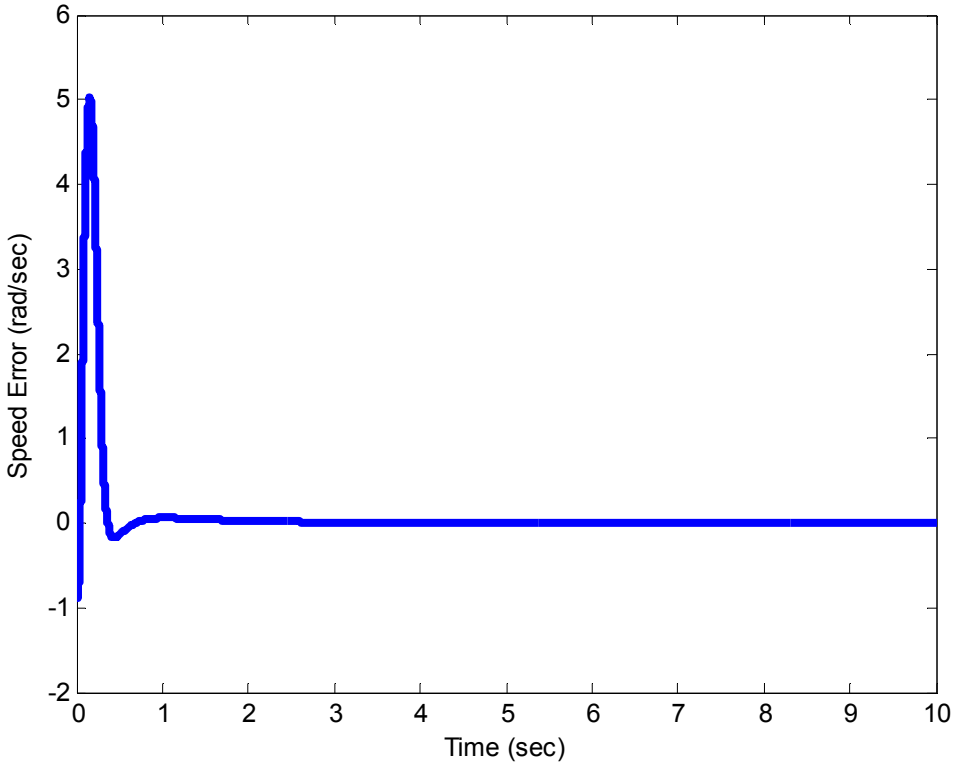

Figure 4.3: The estimated error at low constant speed

4.2.2 High constant speed command

In this case, the performance of the proposed speed sensorless control algorithm is tested under high speed command. The command speed is assumed to be increased from zero to 1000rad/sec under no-load. The simulation is performed for five seconds. The real and estimated speed responses are shown in Figure 4.4. It can be seen that there is a very good accordance between real speed and estimated speed without any steady state error. Figure 4.5 shows the speed error between estimated speed and real

speed. The peak speed error between estimated and actual speeds is within the range +0.06rad/sec and -30rad/sec.

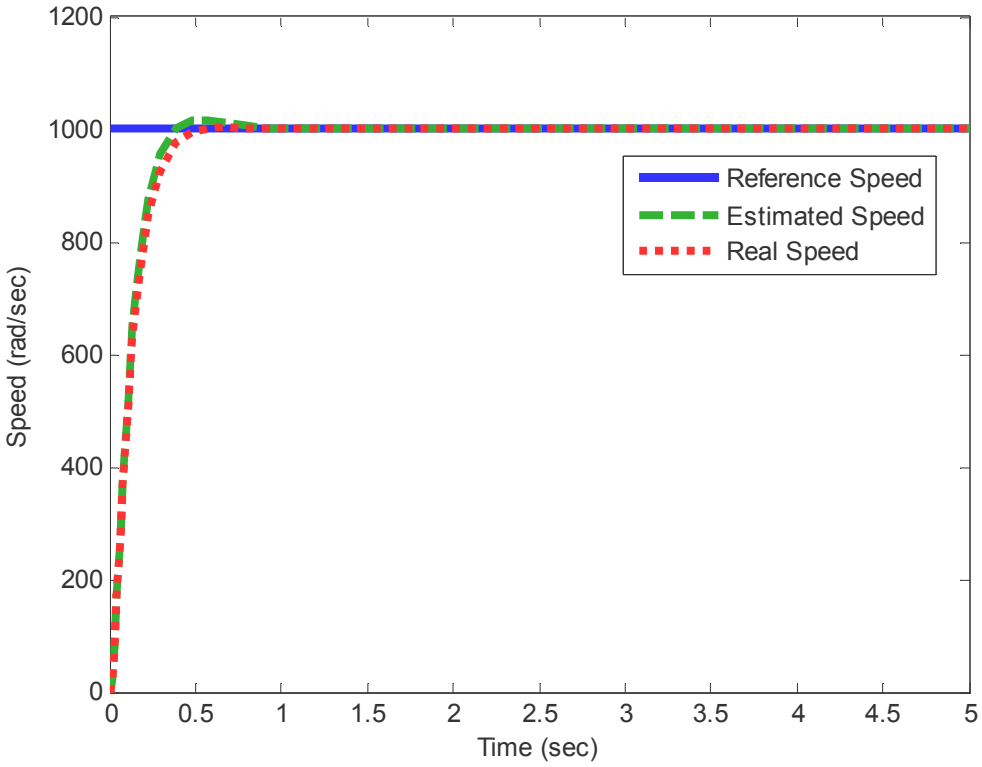

Figure 4.4: The real and estimated speeds at high constant speed

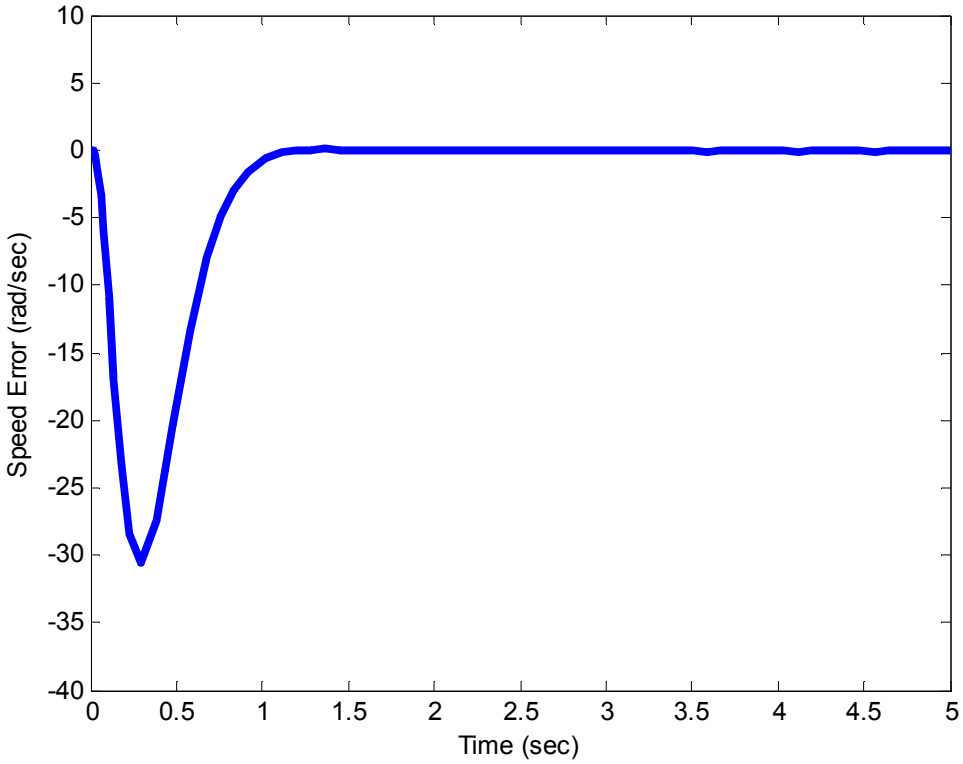

Figure 4.5: The estimated error at high constant speed

4.2.3 Variable speed command

In this case, the performance of the proposed speed sensorless control algorithm is tested under variable speed command. The simulation is performed for ten seconds. The speed command is 50rad/sec for the first two seconds, followed by 80rad/sec for the next two seconds, then 100rad/sec for the next two seconds followed by 50rad/sec for the last four seconds. The real and estimated speed responses are shown in Figure 4.6. It can be seen that there is a very good accordance between real speed and estimated speed. Figure 4.7 is speed error between estimated speed and real speed. The peak speed error between estimated and actual speeds is within the range +4.4rad/sec and -1.98rad/sec.

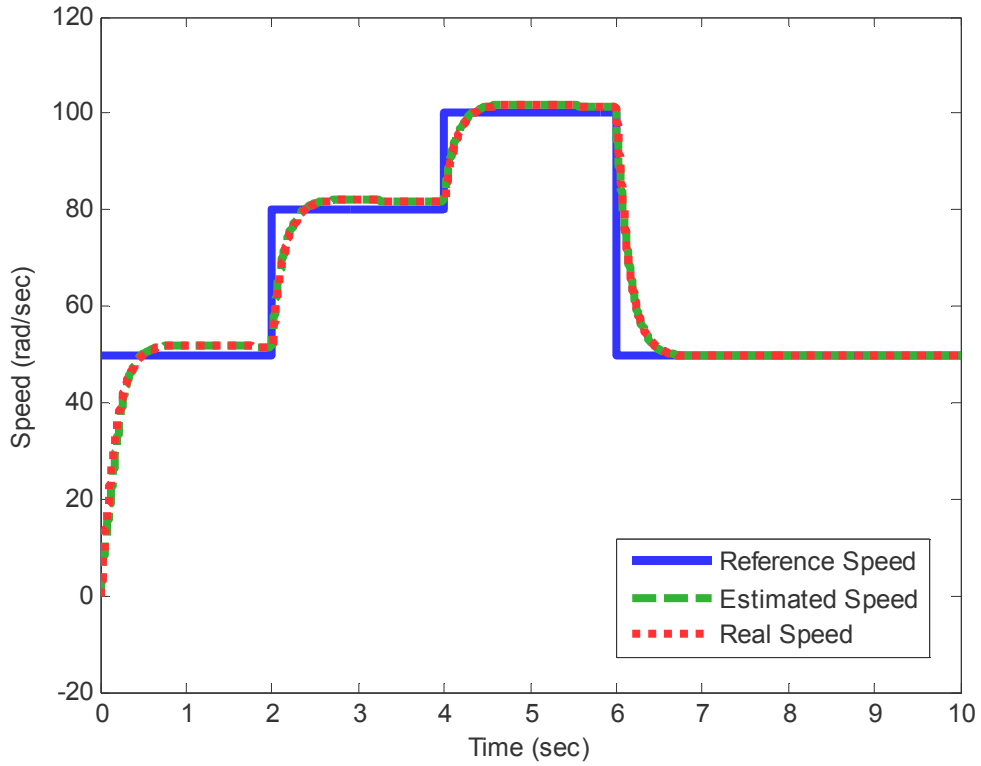

Figure 4.6: The real and estimated speeds at variable speed

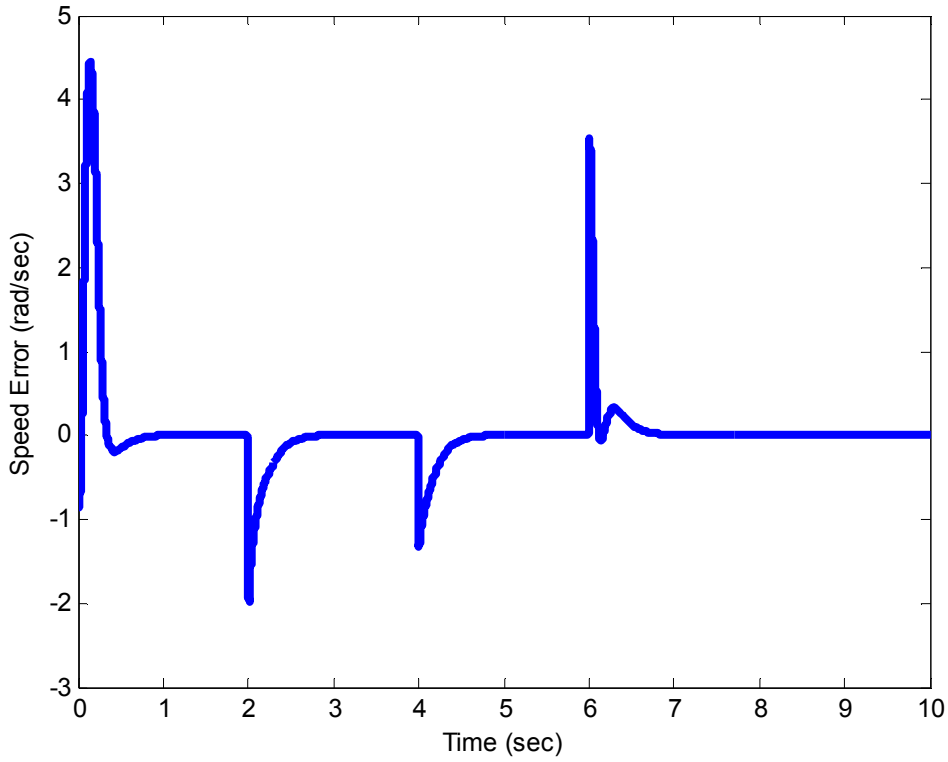

Figure 4.7: The estimated error at variable speed

4.2.4 Inversion of the speed

Figure 4.8 presents the simulation result obtained for speed inverting from 80rad/s to -80rad/s under no torque load. The simulation is performed for ten seconds. Estimated speed, actual speed, and reference speed are shown in this figure. This figure indicates that the estimated speed tracks its real speed very closely in both the forward and reverse directions, and it is possible to verify the excellent behaviour of the proposed speed sensorless control algorithm. In fact, the waveforms depicted through this figure, prove the feasibility of the proposed speed sensorless control scheme. Figure 4.9 shows the speed error or estimated error. The peak speed error between estimated and actual speeds is within the range +5rad/sec and -0.8rad/sec.

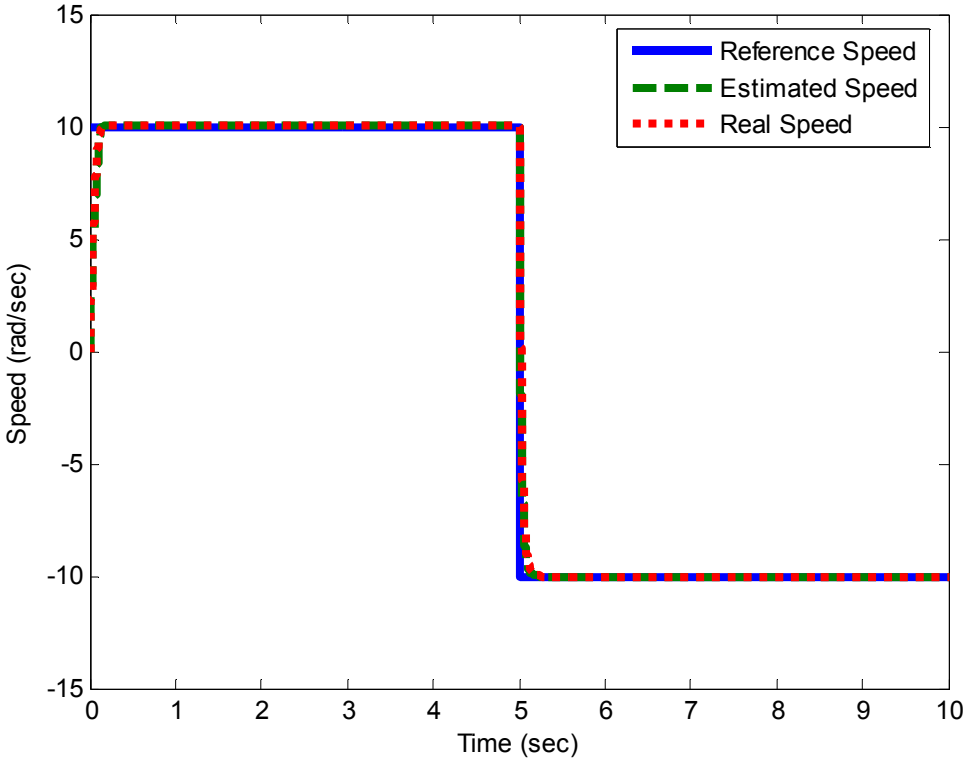

Figure 4.8: The real and estimated speeds with reversing speed reference

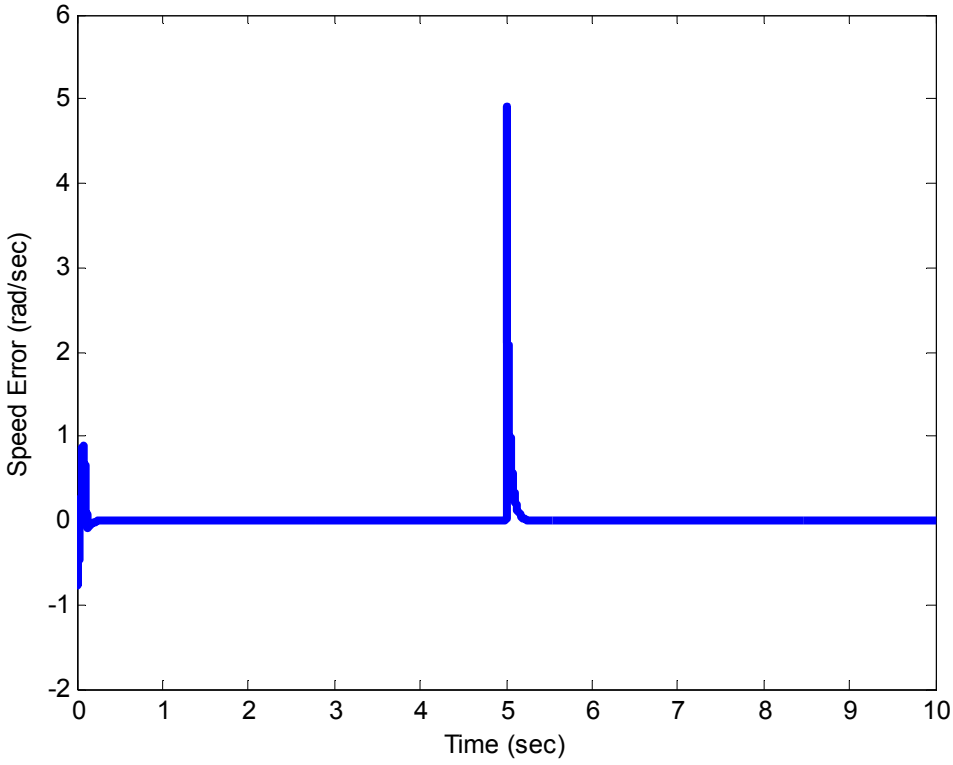

Figure 4.9: The estimated error at reversing speed