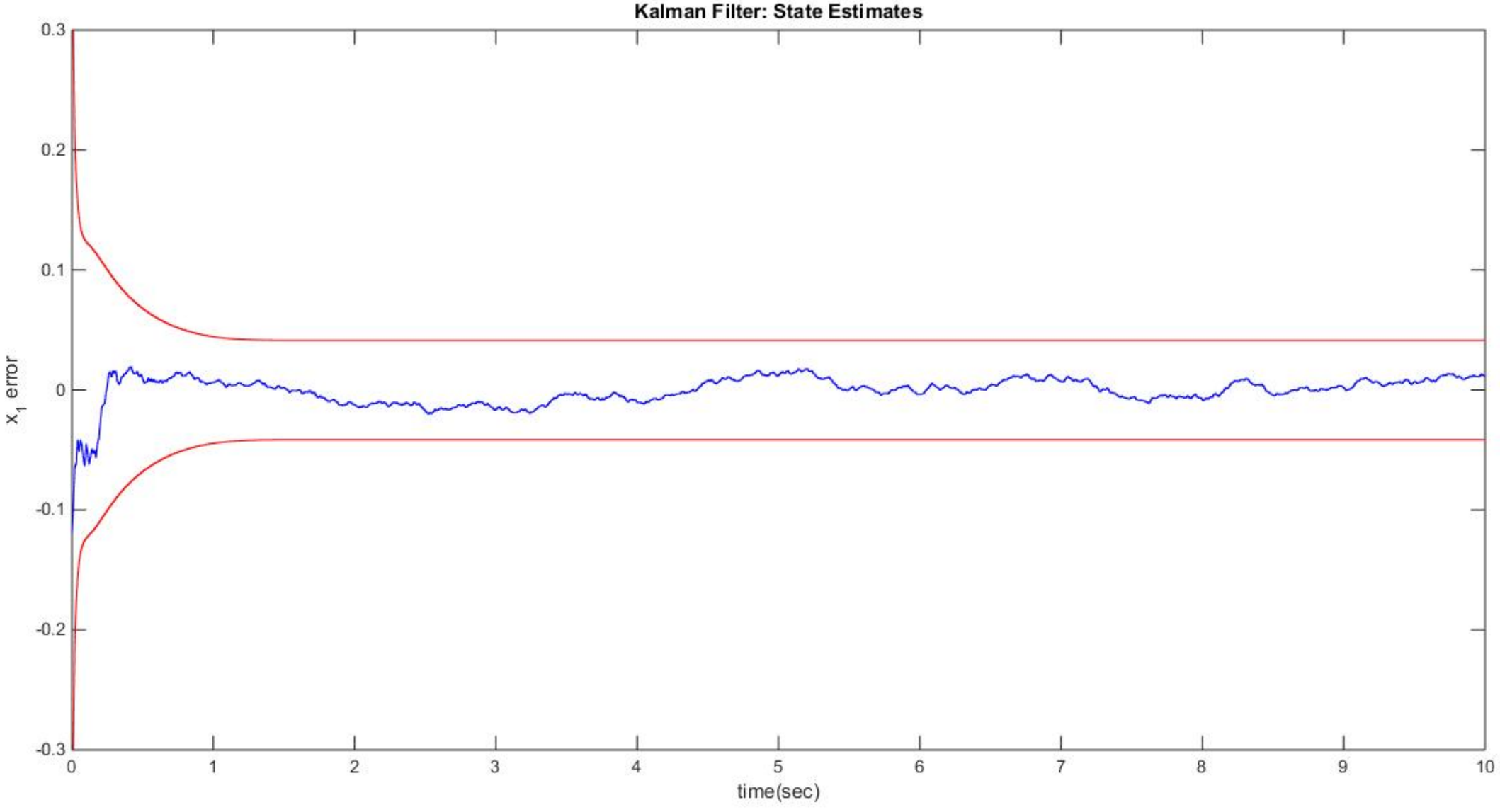
Consider the following truth model for a simple second-order system:

$$\mathbf{x}_{k+1} = \begin{bmatrix} 9.9985 \times 10^{-1} & 9.8510 \times 10^{-3} \\ -2.9553 \times 10^{-2} & 9.7030 \times 10^{-1} \end{bmatrix} \mathbf{x}_k + \begin{bmatrix} 4.9502 \times 10^{-5} \\ 9.8510 \times 10^{-3} \end{bmatrix} w_k$$

$$\tilde{y}_k = \begin{bmatrix} 1 & 0 \end{bmatrix} \mathbf{x}_k + v_k$$

where the sampling interval is given by 0.01 seconds. Using initial conditions of $\mathbf{x}_0 = \begin{bmatrix} 1 & 1 \end{bmatrix}^T$, create a set of 1001 synthetic measurements with the following variances for the process noise and measurement noise: $Q = 1$ and $R = 0.01$. Run the Kalman filter in Table 3.1 with the given model and assumed values for Q and R. Test the convergence of the filter for various state and covariance initial condition errors. Also, compare the computed state errors with their respective 3σ bounds computed from the covariance matrix P_k.


Kalman Filter: State Estimates
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
x1 error
0
1
2
3
4
5
6
7
8
9
10
time(sec)