CHAPTER 4

CONCLUSION

In this work, we study the asymptotic stability of zero solution for neutral system with time-varying delay. We give sufficient conditions for neutral system without uncertainties and neutral system with uncertainties. The main results are summarized as follows:

4.1 Delay-dependent Criterion for Asymptotic Stability of Neutral System without Matrices Uncertainties

Theorem 3.1.1. *For given nonnegative scalars τ_m and τ_M, system (3.6) is asymptotically stable for any $\tau(t)$ satisfying $0 \leq \tau_m \leq \tau(t) \leq \tau_M$, if there exist matrices $P > 0, Q > 0, R > 0, S > 0, Y > 0$ and $L_i, K_i, M_i (i = 1, 2, 3, 4, 5)$ of appropriate dimensions such that*

$$\Sigma_1 = \begin{pmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} & \phi_{15} & 2dM_1^T & 2\tau_e L_1^T & \rho K_1^T B \\ * & \phi_{22} & \phi_{23} & \phi_{24} & \phi_{25} & 2dM_2^T & 2\tau_e L_2^T & \rho K_2^T B \\ * & * & \phi_{33} & \phi_{34} & \phi_{35} & 2dM_3^T & 2\tau_e L_3^T & \rho K_3^T B \\ * & * & * & \phi_{44} & \phi_{45} & 2dM_4^T & 2\tau_e L_4^T & \rho K_4^T B \\ * & * & * & * & \phi_{55} & 2dM_5^T & 2\tau_e L_5^T & \rho K_5^T B \\ * & * & * & * & * & -2dY & 0 & 0 \\ * & * & * & * & * & * & -2\tau_e R & 0 \\ * & * & * & * & * & * & * & -\rho S \end{pmatrix} < 0 \quad (4.1)$$

where

$\phi_{11} = Q + K_1^T A + A^T K_1 + L_1 + L_1^T + M_1^T + M_1 + Q_1$

$\phi_{12} = K_1^T B - L_1^T + A^T K_2 + L_2 + M_2$

$\phi_{13} = -K_1^T + A^T K_3 + L_3 + M_3 + P$

$$\phi_{14} = K_1^T C + A^T K_4 + L_4 + M_4 - PC$$
$$\phi_{15} = A^T K_5 + L_5 + M_5 - M_1$$
$$\phi_{22} = -Q + K_2^T B + B^T K_2 - L_2^T - L_2$$
$$\phi_{23} = -K_2^T + B^T K_3 - L_3$$
$$\phi_{24} = K_2^T C + B^T K_4 - L_4$$
$$\phi_{25} = B^T K_5 - L_5 - M_2$$
$$\phi_{33} = dY + \tau_e R + \rho S - K_3^T - K_3 + Q_2$$
$$\phi_{34} = K_3^T C - K_4$$
$$\phi_{35} = -K_5 - M_3 - PC$$
$$\phi_{44} = K_4^T C + C^T K_4 - Q_2$$
$$\phi_{45} = C^T K_5 - M_4 + CPC^T$$
$$\phi_{55} = -M_5^T - M_5 - Q_1$$

4.2 Delay-dependent Criterion for Asymptotic Stability for Uncertain Neutral System

Theorem 3.2.1 *For given nonnegative scalars* τ_m *and* τ_M*, system (3.1) is asymptotically stable for any* $\tau(t)$ *satisfying* $0 \leq \tau_m \leq \tau(t) \leq \tau_M$ *if there exist some matrices* $P, Q, Q_1, Q_2, R, S, Y > 0$ *and* $L_i, K_i, M_i (i = 1, 2, 3, 4, 5)$ *such that*

$$\Sigma = \begin{pmatrix} \xi_{11} & \xi_{12} & \xi_{13} & \xi_{14} & \xi_{15} & 2dM_1^T & 2\tau_e L_1^T & \rho K_1^T(B+\Delta B(t)) \\ * & \xi_{22} & \xi_{23} & \xi_{24} & \xi_{25} & 2dM_2^T & 2\tau_e L_2^T & \rho K_2^T(B+\Delta B(t)) \\ * & * & \xi_{33} & \xi_{34} & \xi_{35} & 2dM_3^T & 2\tau_e L_3^T & \rho K_3^T(B+\Delta B(t)) \\ * & * & * & \xi_{44} & \xi_{45} & 2dM_4^T & 2\tau_e L_4^T & \rho K_4^T(B+\Delta B(t)) \\ * & * & * & * & \xi_{55} & 2dM_5^T & 2\tau_e L_5^T & \rho K_5^T(B+\Delta B(t)) \\ * & * & * & * & * & -2dY & 0 & 0 \\ * & * & * & * & * & * & -2\tau_e R & 0 \\ * & * & * & * & * & * & * & -\rho S \end{pmatrix} < 0 \quad (4.2)$$

where

$\xi_{11} = \phi_{11} + K_1^T \Delta A(t) + \Delta A(t)^T K_1 + Z_{11}$

$\xi_{12} = \phi_{12} + \Delta A^T(t) K_2 + K_1^T \Delta B(t) + Z_{12}$

$\xi_{13} = \phi_{13} + \Delta A(t)^T K_3 + Z_{13}$

$\xi_{14} = \phi_{14} + \Delta A(t)^T K_4 + Z_{14}$

$\xi_{15} = \phi_{15} + \Delta A(t)^T K_5 + Z_{15}$

$\xi_{22} = \phi_{22} + \Delta B(t)^T K_2 + K_2^T \Delta B(t) + Z_{22}$

$\xi_{23} = \phi_{23} + \Delta B(t)^T K_3 + Z_{23}$

$\xi_{24} = \phi_{24} + \Delta B(t)^T K_4 + Z_{24}$

$\xi_{25} = \phi_{25} + \Delta B(t)^T K_5 + Z_{25}$

and $\phi_{11}, \phi_{12}, \phi_{13}, \phi_{14}, \phi_{15}, \phi_{22}, \phi_{23}, \phi_{24}, \phi_{25}, \phi_{33}, \phi_{34}, \phi_{35}, \phi_{44}, \phi_{45}, \phi_{55}$ *satisfy theorem 3.1.1.*

Theorem 3.2.2 *For given nonnegative scalars τ_m and τ_M, system (3.1) is asymptotically stable for any $\tau(t)$ satisfying $0 \le \tau_m \le \tau(t) \le \tau_M$ if there exist constants $\epsilon > 0$ and some matrices $P, Q, Q_1, Q_2, R, S, Y > 0$ and $L_i, K_i, M_i (i = 1, 2, 3, 4, 5)$ such that*

$$\Sigma_2 = \begin{pmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} & \phi_{15} & 2dM_1^T & 2\tau_e L_1^T & \rho K_1^T B & K_1^T E & \epsilon G^T \\ * & \phi_{22} & \phi_{23} & \phi_{24} & \phi_{25} & 2dM_2^T & 2\tau_e L_2^T & \rho K_2^T B & K_2^T E & \epsilon G_1^T \\ * & * & \phi_{33} & \phi_{34} & \phi_{35} & 2dM_3^T & 2\tau_e L_3^T & \rho K_3^T B & K_3^T E & 0 \\ * & * & * & \phi_{44} & \phi_{45} & 2dM_4^T & 2\tau_e L_4^T & \rho K_4^T B & K_4^T E & 0 \\ * & * & * & * & \phi_{55} & 2dM_5^T & 2\tau_e L_5^T & \rho K_5^T B & K_5^T E & 0 \\ * & * & * & * & * & -2dY & 0 & 0 & 0 & 0 \\ * & * & * & * & * & * & -2\tau_e R & 0 & 0 & 0 \\ * & * & * & * & * & * & * & -\rho S & 0 & 0 \\ * & * & * & * & * & * & * & * & -\epsilon I & 0 \\ * & * & * & * & * & * & * & * & * & -\epsilon I \end{pmatrix} < 0 \tag{4.3}$$

where $\phi_{11}, \phi_{12}, \phi_{13}, \phi_{14}, \phi_{15}, \phi_{22}, \phi_{23}, \phi_{24}, \phi_{25}, \phi_{33}, \phi_{34}, \phi_{35}, \phi_{44}, \phi_{45}, \phi_{55}$ satisfy theorem 3.1.1.