CHAPTER 4

Numerical Result

In this chapter, we present a numerical example to guarantee the effectiveness of the condition obtained in this study.

Example 1 Consider a switched system consists of two subsystem where

$$A_1 = \begin{pmatrix} -1 & 2 \\ -10 & 3 \end{pmatrix}, A_2 = \begin{pmatrix} 1 & 13 \\ -2 & 3 \end{pmatrix}.$$

By the lemma 2.5.4., we have

$$P = \begin{pmatrix} 0.1519 & -1.9748 \\ 0.7596 & 0 \end{pmatrix} \tag{4.1}$$

such that

$$PA_2P^{-1} = \begin{pmatrix} 2.0001 & 4.9996 \\ -5.0004 & 1.9999 \end{pmatrix}.$$

And $\theta_0 = -0.0749$ such that

$$QA_2Q^{-1} = \begin{pmatrix} 2.0001 & 4.9996 \\ -5.0004 & 1.9999 \end{pmatrix} \text{ and } QA_1Q^{-1} = \begin{pmatrix} 1.0003 & 25.3673 \\ -0.6307 & 0.9997 \end{pmatrix}.$$

The subsystem's state matrices can be transformed into

$$A_1' = \begin{pmatrix} 1 & 4/E \\ -4E & 1 \end{pmatrix}, A_2' = \begin{pmatrix} 2 & 5 \\ -5 & 2 \end{pmatrix}, E = 0.1577.$$

From theorem 2.5.1.[7], the switched system that consists of the subsystem 1 and subsystem 2 which have unstable foci can be stabilized when $D > 0$ and $\rho < 1$. For the subsystem 1 and subsystem 2, we have $D = 10.7945$ and $\rho = 2.3457$ where $E = 0.1577$. Thus this switched system cannot be stabilized.

From [7], the switched system with two unstable foci trajectories subsystems cannot be stabilized when $D > 0$ and $\rho < 1$. Therefore, this switched system cannot be stabilized by using the theorem proposed in [7]. However with the condition in the proposed in this study, we will look for the condition of subsystem 3 that

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makes the overall system asymptotically stabilizable.

By the theorem 3.0.1.

$$\alpha_3 \frac{\theta_2 - \theta_3}{\beta_3} < -\frac{\alpha_1 \theta_1}{\beta_1} - \alpha_2 \frac{(\theta_1 - \theta_2)}{\beta_2} - \ln \sqrt{\cos^2(\theta_1) + E^2 \sin^2(\theta_1)} - \ln c \qquad (3.15)$$

where $\theta_1 + \theta_2 + \theta_3 = \pi$ and $c > 1$.
A set of parameters that satisfied (3.15 is)

$$\theta_1 = 0.640,\ \theta_2 = 2.027,\ \theta_3 = 0.470,\ \frac{\alpha_1}{\beta_1} = \frac{1}{4}, \frac{\alpha_2}{\beta_2} = \frac{2}{5} \text{ and } E = 0.15.$$

With these parameters, we have

$$\frac{\alpha_3}{\beta_3} < -0.05$$

and define $A_3 = \begin{pmatrix} -5 & 10 \\ -10 & -5 \end{pmatrix}$. Since the eigenvalues od A_3 is $\lambda_3 = -5 \pm 10j$, thus the third subsystem is stable. The switched system is asymptotically stabilizable, and the solution of the switched system with initial condition $(-10, -4)^T$ is shown in figure 4.1. We can see from the figure that the solution starting from x_0 converges to $(0, 0)^T$.

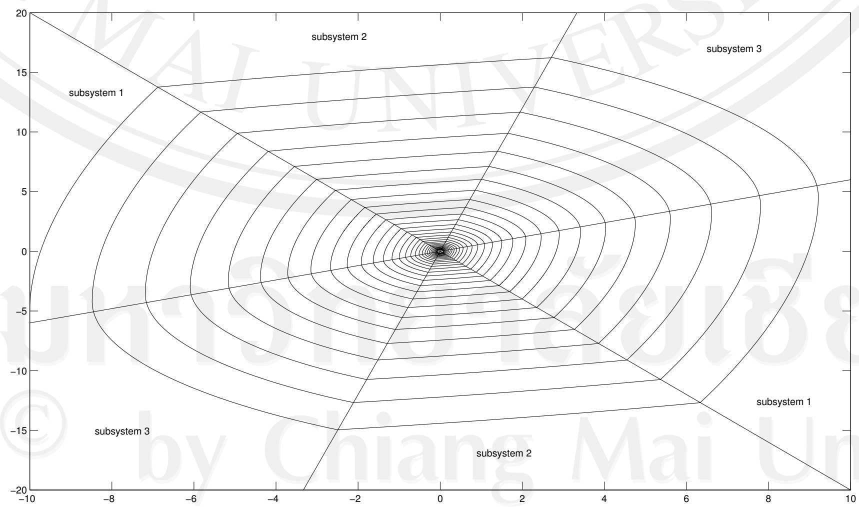

Figure 4.1: Trajectory of example 1

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