

Part IV

Advanced Lyapunov Functions

Lyapunov functions play an important role in the stability analysis of dynamic control systems. Single Lyapunov function is simple to be used to obtain stability conditions. However, compared with a Lyapunov function consisting of multiple local ones, it is potentially prone to achieve conservative stability analysis result. Two advanced Lyapunov functions are introduced to achieve more relaxed stability analysis results.

The first one introduced in Chap. 9 is named switching Lyapunov functions, which consists of a number of local Lyapunov functions. These local Lyapunov functions will switch among them according to a switching rule and one of them will become dominant at an instant to take care of the stability analysis.

The second one introduced in Chap. 10 is named fuzzy Lyapunov function which is an average-weighted sum of a number of local Lyapunov functions. The contribution of each local Lyapunov function to the system stability at an instant is characterized by the membership functions and the rule base of a fuzzy logic system.

As an appropriate local Lyapunov function is used in the stability analysis according to the system working conditions, it demonstrates a potential to come up with more relaxed stability analysis results. However, the stability analysis will be more challenging as more constraints have to be considered to make sure that the advanced Lyapunov functions are valid.