APPENDIX

Appendix A

Basic and Auxiliary Results

A.1 Selection of c

During the sliding mode, let

$$s(k) = c\Big[x(k) - x_d(k)\Big] = 0, \tag{A.1}$$

we obtain

$$\sum_{i=1}^{N} c_i x_i(k) = \sum_{i=1}^{N} c_i x_{di}(k), \tag{A.2}$$

applying the Z-transform, we obtain

$$\sum_{i=1}^{N} c_i X_i(z) = \sum_{i=1}^{N} c_i X_{di}(z) \tag{A.3}$$

From the system relation

$$x_n(k) = x_{n+1}(k-1) \tag{A.4}$$

for $n = 1, \cdots, N-1$. Apply Z-Transformation we obtain

$$\left.\begin{array}{rcl} X_1(z) & = & z^{-1}X_2(z) \\ X_2(z) & = & z^{-1}X_3(z) \\ \vdots & & \vdots \\ X_{N-1}(z) & = & z^{-1}X_N(z). \end{array}\right\} \tag{A.5}$$

or

$$X_i(z) = z^{-(N-i)}X_N(z). \tag{A.6}$$

Then Eq.(A.3) can be rewritten as

$$\begin{aligned} \sum_{i=1}^{N} c_i z^{-(N-i)} X_N(z) &= \sum_{i=1}^{N} c_i X_{di}(z) \\ X_N(z) &= \frac{\sum_{i=1}^{N} c_i X_{di}(z)}{\sum_{i=1}^{N} c_i z^{-(N-i)}}. \end{aligned}$$

The characteristic equation of this system is

$$\sum_{i=1}^{N} c_i z^{-(N-i)} = c_N + c_{N-1}z^{-1} + \cdots + c_1 z^{-(N-1)} = 0. \tag{A.7}$$

This means the roots of this characteristic equation must be kept inside the unit disk for the system stability.

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