PRETKOMPENZATOR REDUCIRANOG REDA – SINTEZA U DISKRETNOM PODRUČJU

Prijenosna funkcija slijednog sustava glasi:

$$G(z) = \frac{B(z)}{A(z)} = \frac{b_m z^m + b_{m-1} z^{m-1} + \cdots + b_1 z + b_0}{a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 z + a_0}$$

gdje su:

A(z) – polovi zatvorenog kruga slijednog sustava

B(z)- nule pretkompenzatora kompenziraju utjecaj polova A(z) radi ubrzavanja odziva slijednog sustava s obzirom na referencu ili smanjenja pogreške slijeđenja reference

Uvjeti koje treba zadovoljiti prijenosna funkcija G(z)

- Uvjet točnosti u stacionarnom stanju: G(1)=1

$$b_m + b_{m-1} + \cdots + b_1 + b_0 = a_m + a_{m-1} + \cdots + a_1 + a_0 = a_\varepsilon$$

- Primjena jednadžbi modulnog optimuma: amplitudno-frekvencijska karakteristika će zadržati vrijednost 1 u širokom opsegu frekvencija

  Konačne jednadžbe modulnog optimuma:

$$K^2(a_1^* + 2a_2^* + \cdots + n^2 a_n^*) = b_1^* + 2b_2^* + \cdots + m^2 b_m^*$$

$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots$$

$$K^2\left(a_1^* + 2^{2i} a_2^* + \cdots + n^{2i} a_n^*\right) = b_1^* + 2^{2i} b_2^* + \cdots + m^{2i} b_m^*$$

$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots$$

$$K^2\left(a_1^* + 2^{2(n-1)} a_2^* + \cdots + n^{2(n-1)} a_n^*\right) = b_1^* + 2^{2(n-1)} b_2^* + \cdots + m^{2(n-1)} b_m^*$$

gdje su a_i^* , b_i^* I K dani izrazima:

$$a_i^* = a_0 a_1 + a_1 a_2 + \cdots + a_{n-1} a_n \ , \ \ i = 1,2,\dots,n$$

$$b_i^* = b_0 b_1 + b_1 b_2 + \cdots + b_{m-1} b_m \ , \ \ i = 1,2,\dots,m$$

$$K = G(1) = \frac{b_m + b_{m-1} + \cdots + b_1 + b_0}{a_m + a_{m-1} + \cdots + a_1 + a_0}$$

Iz uvjeta točnosti u stacionarnom stanju vrijedi K=1.

Kad se konačne jednadžbe modulnog optimuma prikažu matrično uz uvjet točnosti u stacionarnom stanju dobije se sljedeći prikaz:

$$\begin{bmatrix} 1^2 & 2^2 & \cdots & m^2 \\ 1^4 & 2^4 & \cdots & m^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2m} & 2^{2m} & \cdots & m^{2m} \end{bmatrix} \begin{bmatrix} b_1^* \\ b_2^* \\ \vdots \\ b_m^* \end{bmatrix} = \begin{bmatrix} 1^2 & 2^2 & \cdots & n^2 \\ 1^4 & 2^4 & \cdots & n^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2n} & 2^{2n} & \cdots & n^{2n} \end{bmatrix} \begin{bmatrix} a_1^* \\ a_2^* \\ \vdots \\ a_n^* \end{bmatrix}$$

Množenjem jednadžbe s $\begin{bmatrix} 1^2 & 2^2 & \cdots & m^2 \\ 1^4 & 2^4 & \cdots & m^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2m} & 2^{2m} & \cdots & m^{2m} \end{bmatrix}^{-1}$ slijeva dobije se izraz

$$\begin{bmatrix} b_1^* \\ b_2^* \\ \vdots \\ b_m^* \end{bmatrix} = \begin{bmatrix} 1^2 & 2^2 & \cdots & m^2 \\ 1^4 & 2^4 & \cdots & m^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2m} & 2^{2m} & \cdots & m^{2m} \end{bmatrix}^{-1} \begin{bmatrix} 1^2 & 2^2 & \cdots & n^2 \\ 1^4 & 2^4 & \cdots & n^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2n} & 2^{2n} & \cdots & n^{2n} \end{bmatrix} \begin{bmatrix} a_1^* \\ a_2^* \\ \vdots \\ a_n^* \end{bmatrix}$$

Izrazi za a_i^* i b_i^* se prikažu matrično I uvrste u gornji izraz:

$$\begin{bmatrix} a_1^* \\ a_2^* \\ \vdots \\ a_n^* \end{bmatrix} = \begin{bmatrix} 0 & a_0 & a_1 & \cdots & a_{n-2} & a_{n-1} \\ 0 & 0 & a_0 & \cdots & a_{n-3} & a_{n-2} \\ 0 & 0 & 0 & \cdots & a_{n-4} & a_{n-3} \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 0 & a_0 \\ 1 & 1 & 1 & \cdots & 1 & 1 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ \vdots \\ a_{n-1} \\ a_\varepsilon \end{bmatrix}$$

$$\begin{bmatrix} b_1^* \\ b_2^* \\ \vdots \\ b_m^* \end{bmatrix} = \begin{bmatrix} 0 & b_0 & b_1 & \cdots & b_{m-2} & b_{m-1} \\ 0 & 0 & b_0 & \cdots & b_{m-3} & b_{m-2} \\ 0 & 0 & 0 & \cdots & b_{m-4} & b_{m-3} \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 0 & b_0 \\ 1 & 1 & 1 & \cdots & 1 & 1 \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ \vdots \\ b_{m-1} \\ a_\varepsilon \end{bmatrix}$$

$$\begin{bmatrix} b_1^* \\ b_2^* \\ \vdots \\ b_m^* \end{bmatrix} = \begin{bmatrix} 1^2 & 2^2 & \cdots & m^2 \\ 1^4 & 2^4 & \cdots & m^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2m} & 2^{2m} & \cdots & m^{2m} \end{bmatrix}^{-1} \begin{bmatrix} 1^2 & 2^2 & \cdots & n^2 \\ 1^4 & 2^4 & \cdots & n^4 \\ \vdots & \vdots & \ddots & \vdots \\ 1^{2n} & 2^{2n} & \cdots & n^{2n} \end{bmatrix} \begin{bmatrix} 0 & a_0 & a_1 & \cdots & a_{n-2} & a_{n-1} \\ 0 & 0 & a_0 & \cdots & a_{n-3} & a_{n-2} \\ 0 & 0 & 0 & \cdots & a_{n-4} & a_{n-3} \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 0 & a_0 \\ 1 & 1 & 1 & \cdots & 1 & 1 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ \vdots \\ a_{n-1} \\ a_\varepsilon \end{bmatrix}$$