Mechatronische Netzwerke

Eigenschaften eines Transformators

Impedanztransformation (Kettenmatrix)

Transformator in Kettenform (A-Matrix)

$$\begin{bmatrix} Y_1 \\ I_{X1} \end{bmatrix} = \begin{bmatrix} A_{11} & 0 \\ 0 & A_{22} \end{bmatrix} \cdot \begin{bmatrix} Y_2 \\ I_{X2} \end{bmatrix}$$

reziproker Wandler ($|A| = 1$)

$$A_{22} = A_{11}^{-1}$$

Impedanztransformation (allgemein)

$$Z_1 = \frac{A_{11}}{A_{22}} \cdot Z_2$$

Widerstand R

$$Z_2 = R_2$$

$$Z_1 = \frac{A_{11}}{A_{22}} \cdot R_2 = R_1$$

Transformationsbeziehung (R)

$$R_1 = \frac{A_{11}}{A_{22}} \cdot R_2$$

Induktivität L

$$Z_2 = 1\mathrm{i} \cdot \omega \cdot L_2$$

$$Z_1 = \frac{A_{11}}{A_{22}} \cdot 1\mathrm{i} \cdot \omega \cdot L_2 = 1\mathrm{i} \cdot \omega \cdot L_1$$

Transformationsbeziehung (L)

$$L_1 = \frac{A_{11}}{A_{22}} \cdot L_2$$

Kapazität C

$$Z_2 = \frac{1}{1\mathrm{i} \cdot \omega \cdot C_2}$$

$$Z_1 = \frac{A_{11}}{A_{22}} \cdot \frac{1}{1\mathrm{i} \cdot \omega \cdot C_2} = \frac{1}{1\mathrm{i} \cdot \omega \cdot C_1}$$

Transformationsbeziehung (C)

$$C_1 = \frac{A_{22}}{A_{11}} \cdot C_2$$

Reihenschaltung

$$Z_2 = Z_{21} + Z_{22}$$

$$Z_1 = \frac{A_{11}}{A_{22}} \cdot Z_2 = \frac{A_{11}}{A_{22}} \cdot Z_{21} + \frac{A_{11}}{A_{22}} \cdot Z_{22} = Z_{11} + Z_{22}$$

Transformationsbeziehung (Z)

$$Z_{11} = \frac{A_{22}}{A_{11}} \cdot Z_{21} \qquad Z_{12} = \frac{A_{22}}{A_{11}} \cdot Z_{22}$$

Parallelschaltung

$$Y_2 = Y_{21} + Y_{22}$$

$$Z_1 = \frac{A_{11}}{A_{22}} \cdot \frac{1}{Y_2} = \frac{A_{11}}{A_{22}} \cdot \frac{1}{Y_{21} + Y_{22}}$$

$$\frac{1}{Y_1} = \frac{A_{11}}{A_{22}} \cdot \frac{1}{Y_{21} + Y_{22}} = \frac{1}{Y_{11} + Y_{12}}$$

$$\frac{A_{22} \cdot Y_{21} + A_{22} \cdot Y_{22}}{A_{11}} = Y_{11} + Y_{12}$$

Transformationsbeziehung (Z)

$$Z_{11} = \frac{A_{11}}{A_{22}} \cdot Z_{21} \qquad Z_{12} = \frac{A_{11}}{A_{22}} \cdot Z_{22}$$

aktive Bauelemente

$$\begin{bmatrix} Y_1 \\ I_{X1} \end{bmatrix} = \begin{bmatrix} A_{11} & 0 \\ 0 & A_{22} \end{bmatrix} \cdot \begin{bmatrix} Y_2 \\ -I_{X2} \end{bmatrix}$$

Transformationsbeziehungen

$$Y_1 = A_{11} \cdot Y_2$$

$$I_{X1} = -A_{22} \cdot I_{X2}$$

Impedanztransformation (Hybridmatrix)

Transformator in Hybridform (H-Matrix)	$\begin{bmatrix} Y_1 \\ I_{X2} \end{bmatrix} = \begin{bmatrix} 0 & H_{12} \\ H_{21} & 0 \end{bmatrix} \cdot \begin{bmatrix} I_{X1} \\ Y_2 \end{bmatrix}$
reziproker Wandler	$H_{12} = -H_{21}$
Impedanztransformation (allgemein)	$Z_1 = -H_{12} \cdot H_{21} \cdot Z_2$

Widerstand R

	$Z_2 = R_2$
Transformationsbeziehung (R)	$R_1 = -H_{12} \cdot H_{21} \cdot R_2$

Induktivität L

	$Z_2 = 1\mathrm{i} \cdot \omega \cdot L_2$
Transformationsbeziehung (L)	$L_1 = -H_{12} \cdot H_{21} \cdot L_2$

Kapazität C

	$Z_2 = \frac{1}{1\mathrm{i} \cdot \omega \cdot C_2}$
Transformationsbeziehung (C)	$C_1 = \frac{-1}{H_{12} \cdot H_{21}} \cdot C_2$

Reihenschaltung

	$Z_2 = Z_{21} + Z_{22}$
Transformationsbeziehung (Z)	$Z_{11} = \frac{-1}{H_{12} \cdot H_{21}} \cdot Z_{21}$
	$Z_{12} = \frac{-1}{H_{12} \cdot H_{21}} \cdot Z_{22}$

Parallelschaltung

$$Y_2 = Y_{21} + Y_{22}$$

Transformationsbeziehung (Z)

$$Z_{11} = -H_{12} \cdot H_{21} \cdot Z_{21}$$

$$Z_{12} = -H_{12} \cdot H_{21} \cdot Z_{22}$$

aktive Bauelemente

$$\begin{bmatrix} Y_1 \\ I_{X2} \end{bmatrix} = \begin{bmatrix} 0 & H_{12} \\ H_{21} & 0 \end{bmatrix} \cdot \begin{bmatrix} I_{X1} \\ Y_2 \end{bmatrix}$$

Transformationsbeziehungen

$$Y_1 = H_{12} \cdot Y_2$$

$$I_{X1} = \frac{1}{H_{21}} \cdot I_{X2}$$