

The following shows the original form of the impedance matrix for the balanced 3-phase wound field induction machine prior to the application of the passive transformations C_1 and C_2 . This is shown to give some appreciation of the existence of passive transformations.....

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(K446)

• Original $1/\omega$ matrix consists of 36 non-zero terms
 → 6 volt equations, depending of 6 currents

• Application of $C_1 \Rightarrow$ non-zero terms reduce

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

$V_1, I_1 \Rightarrow$ stator & $V_2, I_2 =$ rotor

$$\begin{bmatrix} V_a \\ V_b \\ V_c \\ V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} \boxed{} & \boxed{} \\ \boxed{} & \boxed{} \\ \boxed{} & \boxed{} \\ \boxed{} & \boxed{} \\ \boxed{} & \boxed{} \\ \boxed{} & \boxed{} \end{bmatrix} \begin{bmatrix} I_a \\ I_b \\ I_c \\ I_a \\ I_b \\ I_c \end{bmatrix}$$

Z_{11} Z_{12}
 Z_{21} Z_{22}

$$Z' = C_t Z C = \begin{bmatrix} C_{1t} Z_{11} C_1 & C_{1t} Z_{12} C_1 \\ C_{1t} Z_{21} C_1 & C_{1t} Z_{22} C_1 \end{bmatrix}$$

• Stator - stator, Z_{11}

$$= \begin{matrix} & \text{A} & \text{B} & \text{C} \\ \begin{matrix} \text{A} \\ \text{B} \\ \text{C} \end{matrix} & \begin{bmatrix} (R_1 + L_1 p) & M_{12} p & M_{13} p \\ M_{12} p & (R_1 + L_1 p) & M_{13} p \\ M_{13} p & M_{12} p & (R_1 + L_1 p) \end{bmatrix} \end{matrix}$$

• Rotor - rotor, Z_{22}

$$= \begin{matrix} & \text{a} & \text{b} & \text{c} \\ \begin{matrix} \text{a} \\ \text{b} \\ \text{c} \end{matrix} & \begin{bmatrix} (R_2 + L_2 p) & M_{23} p & M_{21} p \\ M_{23} p & (R_2 + L_2 p) & M_{21} p \\ M_{21} p & M_{23} p & (R_2 + L_2 p) \end{bmatrix} \end{matrix}$$

• Rotor - stator, Z_{21}

$$\begin{matrix} & \text{A} & \text{B} & \text{C} \\ \begin{matrix} \text{a} \\ \text{b} \\ \text{c} \end{matrix} & \begin{bmatrix} M_{p1} \cos \theta + M_{31} p \cos 3\theta & M_{p1} \cos \theta_3 + M_{31} p \cos 3\theta & M_{p1} \cos \theta_2 + M_{31} p \cos 3\theta \\ M_{p2} \cos \theta_2 + M_{32} p \cos 3\theta & M_{p1} \cos \theta + M_{31} p \cos 3\theta & M_{p1} \cos \theta_3 + M_{31} p \cos 3\theta \\ M_{p3} \cos \theta_3 + M_{33} p \cos 3\theta & M_{p1} \cos \theta_2 + M_{31} p \cos 3\theta & M_{p1} \cos \theta + M_{31} p \cos 3\theta \end{bmatrix} \end{matrix}$$

• Stator - rotor, Z_{12}

- coefficient of mutual inductance is same between 2 windings, whichever is made the primary...

$\Rightarrow Z_{12} = Z_{21}$

$$\begin{matrix} \text{A} \\ \text{B} \\ \text{C} \end{matrix} \begin{bmatrix} \text{a} & \text{b} & \text{c} \\ - & - & - \\ - & - & - \\ - & - & - \end{bmatrix}$$