Advance electric Drive:-

Section : B

Induction motor Drives:

≫ Different transformations and Reference frame theory:

Abstract: A change of variables is often used to reduce the complexity of the differential equations (voltage equations) that describe the behaviour of electric machines.

The refrence frame transformation components allow simplification of analysis of three phase AC circuits by performing projection of the three-phase quantities onto two stationary axes and by rotating the axes synchronously with the refrence frequency. This section explaine the implementation of these transformations and describe the different configurations that can be applied to them.

Reference frame transformation components are:

- ABC to $\alpha\beta$
- ABC to DQ
- $\alpha\beta$ to ABC
- $\alpha\beta$ to ABC
- $\alpha\beta$ to DQ
- DQ to ABC

and

- DQ to $\alpha\beta$

again Transformation: The process of replacing one set of variables by another related set of variables is called transformation.

In the study of power system and electrical machine analysis, mathematical transformations are often used to decouple variables, to facilitate the solution of difficult equations with the time-varying coefficients, or to refer all variables to a common referance frame.

Evalution of transformation technique:

(for Synchronous machine) → 1920

He transformed a change of variables (voltage, currents and flux linkages) associated with the stator windings of a synchronous machine to a variables associated with fictious windings rotating with the rotor at synchronous speed.

Note:- The stator variables are transformed to a synchronously rotating reference frame fixed in the rotor.

E. Clarke - Transformation:

He transformed a change of variables associated with the sationary ckts. to a variable associated with stationary refrence frame.

The stationary two-phase variables of clarke's transformation are denoted as α and β (Both are orthogonal).

2) Advantages of refrence frame transformation:

1.) The number of voltage equations are reduced.
2.) The time-varying voltage equations become time-invariant ones.
3.) performance of power systems and electric machines can be analyzed without complexities in the voltage equations.
4.) Transformations make it possible for control algorithms to be implemented on DSP.
5.) with aid of this technique, many of the basic concepts and interpretations of this transformations are concisely established.

Equations of transformation:

Change of variables:-

Transformation at the 3-phase variables at stationary circuit elements to the arbitrary refrence frame.

Let us, consider Fig 1. Shows 3 windings for the three-phase a, b and c.

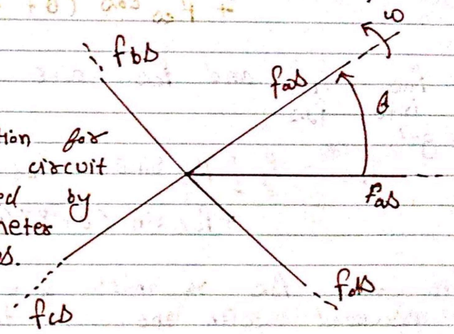

Fig 1: Transformation for stationary circuit represented by trignometer relationships.

With the excitation at phase 'a', 'f' of phas 'a' is resolved into two components.
one component on 'd' axis, named fds.
and the other on the 'q' axis. name fqs.

In fig 1. fas, fbs and fcs are displaced by 120°.
The angular displacement θ must be

continous and f_{qs}, f_{ds} are rotating at an angular velocity at (ω).

If f_{as}, f_{bs} and f_{cs} are resolved into f_{qs}.

we get,

$$f_{qs} = \frac{2}{3}\left[f_{as}\cos\theta + f_{bs}\cos(\theta - 2\pi/3) + f_{cs}\cos(\theta + 2\pi/3)\right] \to ①$$

If f_{as}, f_{bs} and f_{cs} are resolved into f_{ds}

we get,

$$f_{ds} = \frac{2}{3}\left[f_{as}\sin\theta + f_{bs}\sin(\theta - 2\pi/3) + f_{cs}\sin(\theta + 2\pi/3)\right] \to ②$$

Note that f_{os} variables are not associated with the arbitrary reference frame and also independent at θ.

$$f_{os} = \frac{1}{3}\left[f_{as} + f_{bs} + f_{cs}\right] \to ③$$

The equations ①, ② & ③ can be written in matrix form.

$$\begin{bmatrix} f_{qs} \\ f_{ds} \\ f_{os} \end{bmatrix} = \frac{2}{3}\begin{bmatrix} \cos\theta & \cos(\theta - 2\pi/3) & \cos(\theta + 2\pi/3) \\ \sin\theta & \sin(\theta - 2\pi/3) & \sin(\theta + 2\pi/3) \\ 1/2 & 1/2 & 1/2 \end{bmatrix}\begin{bmatrix} f_{as} \\ f_{bs} \\ f_{cs} \end{bmatrix} \to ④$$

The equation (4) may be expressed as:

$$f_{qdos} = K_s f_{abcs} \to ⑤$$

$$(f_{qdos})^T = [f_{qs} \quad f_{ds} \quad f_{os}] \to ⑥$$

$$(f_{abcs})^T = [f_{as} \quad f_{bs} \quad f_{cs}] \to ⑦$$

$$K_s = \frac{2}{3}\begin{bmatrix} \cos\theta & \cos(\theta - 2\pi/3) & \cos(\theta + 2\pi/3) \\ \sin\theta & \sin(\theta - 2\pi/3) & \sin(\theta + 2\pi/3) \\ 1/2 & 1/2 & 1/2 \end{bmatrix} \to ⑧$$

$$\omega = \frac{d\theta}{dt} \to ⑨$$

$$\theta = \int \omega\, dt \to ⑩$$

Modeling of induction machines.

objectives:

AC motor control is to make the rotor turn at a desired speed despite load variations by d-q modeling.

Diagram on next page.

📄 Preview Ends Here

🔒 Download Full Notes (Password Protected)

This PDF is only a **preview**.
To download the **complete Notes PDF**, please follow the steps below:

👉 How to Get Full Notes PDF

1. Visit the Notes Page on our website
2. Fill the Notes Access Form
3. Enter correct details only
4. Submit the form

📩 *You will receive the PDF password instantly on your email*

⚠️ Important Notice

- This system is only for serious students
- Please fill the form with correct information
- Wrong or fake details may block password access

🎓 For Serious Students Only

This content is shared strictly for educational purposes.
