Simulation ofAsynchronous Motor

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ABSTRACT

This paper deals with the problem of simulation of the mathematical model of asynchronous motor using (d-q axis). Model applied MATLAB (simulik program) to deal with parameters of three phase asynchronous motor after its discription using mathematical equations and gives us the results as grafical curves,which discribe behaviors of motor under effect of different load torque.
The results obtained from test correspod to theoretical curves of an asynchronous motor.

Introdiction

Three-phase induction machine are asynchronous speed machine,operating below synchronous speed when motoring and above synchronous speed when generating. They are comparatively less expensive to an equivalent size synchronous or dc machine in the range of size from a few watts to 10000W. They, indeed,are the workhorses of today's industry. As motors,they are regged and require very little maintenance. However,their speed is not easily controlled as with dc motors.They draw large starting currents, typically about four to eight times of full load values,and operate with poor lagging power factor when lightly loaded.
To create a mathematical model of the problem to be solved it is very important to do the following steps:
a)Determine what fundamental principles are applicable.
b)Draw sketches or block diagram to better understand the problem
c.Define necessary variables and assign notation.
d)Reduce the problem as originally stated into one expressed in purely mathematical terms.
e)Apply mathematical expertise to extract the essentials from the underlying physical description of the problem.
f)Simplify the problem enough to allow the required information and result to be obtained.
g)Identify and justify the assumptions and constraints inherent in the model.
Using the above information I made the model to establish solving the problem of simulation of three phase induction machine working as motor.

Model of asynchronous motor

1.Space vectors and their linear transformation

Double pole machine: For simple solution we suppose the following:

a) symmetrical harmonical source voltage

b) symmetrical winding (R a L) for stator and rotor the same resistance and reactance. Refer (R and X) of rotor to stator side.

c) ignor iron losses.

Motor consists of three phase winding with phase shift of 2Π/3 (see Fig.1). Complex stator current is:

$$\bar{i}_1 = \frac{2}{3}\left(i_{1a} + i_{1b} e^{j\frac{2\pi}{3}} + i_{1c} e^{-j\frac{2\pi}{3}}\right) \qquad (1)$$

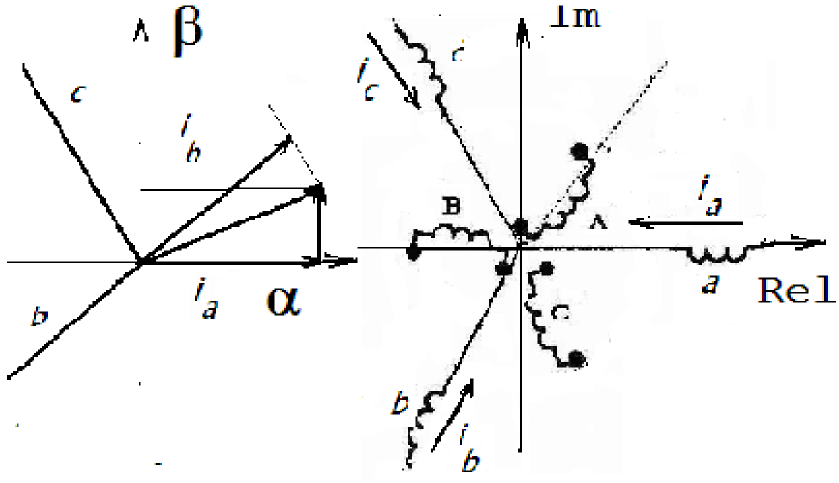
It is chosen to be phase current in axis **a**. Equation (1) can be divided to real and imagnear parts.

$$\bar{i}_1 = \frac{2}{3}\left[i_{1a} + i_{1b}\left(\cos\frac{2\pi}{3} + j\sin\frac{2\pi}{3}\right) + i_{1c}\cdot\left(\cos\frac{2\pi}{3} - j\sin\frac{2\pi}{3}\right)\right] =$$

$$= \frac{2}{3}\left[i_{1a} + (i_{1b} + i_{1c})\cdot\cos\frac{2\pi}{3} + j(i_{1b} - i_{1c})\cdot\sin\frac{2\pi}{3}\right] \qquad (2)$$

$$i_{1a} + i_{1b} + i_{1c} = 0 \qquad (3)$$

$$\bar{i}_1 = \frac{2}{3}\left[i_{1a}\left(1 + \frac{1}{2}\right) + j(i_{1b} - i_{1c})\cdot\frac{\sqrt{3}}{2}\right] \qquad (4)$$



a. Three phase curents in axis β,α

b. Three phase winding of stator and rotor

Figure. 1

Solving above equations using suitable mathemetical methods and using suitable transformation of three phase axis to (d-q axis) model to obtain the following mathematical equations which represent the mathematical model of three phase asynchronous motor.

$$\frac{d\bar{i}_{1\alpha}}{dt} = \frac{L_2}{L_1 L_2 - L_h^2}\left[-\left(R_1 + R_2 \frac{L_1}{L_2}\right) i_{1\alpha} + \frac{R_2}{L_2}\Psi_{1\alpha} + \omega \Psi_{1\beta} + u_{1\alpha}\right] - \omega\, i_{1\beta} \qquad (2)$$

$$\frac{d\bar{i}_{1\beta}}{dt} = \frac{L_2}{L_1 L_2 - L_h^2}\left[-\left(R_1 + R_2 \frac{L_1}{L_2}\right) i_{1\beta} + \frac{R_2}{L_2}\bar{\Psi}_{1\beta} - \omega \Psi_{1\alpha} + u_{1\beta}\right] + \omega\, \bar{i}_{1\alpha} \qquad (3)$$

$$\frac{d\bar{\Psi}_{1\alpha}}{dt} = -R_1 i_{1\alpha} + u_{1\alpha} \qquad (4)$$

$$\frac{d\bar{\Psi}_{1\beta}}{dt} = -R_1 i_{1\beta} + u_{1\beta} \qquad (5)$$

$$\frac{d\omega}{dt} = \frac{P_P}{J}\left[\frac{3}{2} P_P \left(\Psi_{1\alpha} i_{1\beta} - \Psi_{1\beta} i_{1\alpha}\right) - m_z\right] \qquad (6)$$

Than the above equations are solved using MATLAB (simulink program) to get grafical curves one can see in the figures below: -

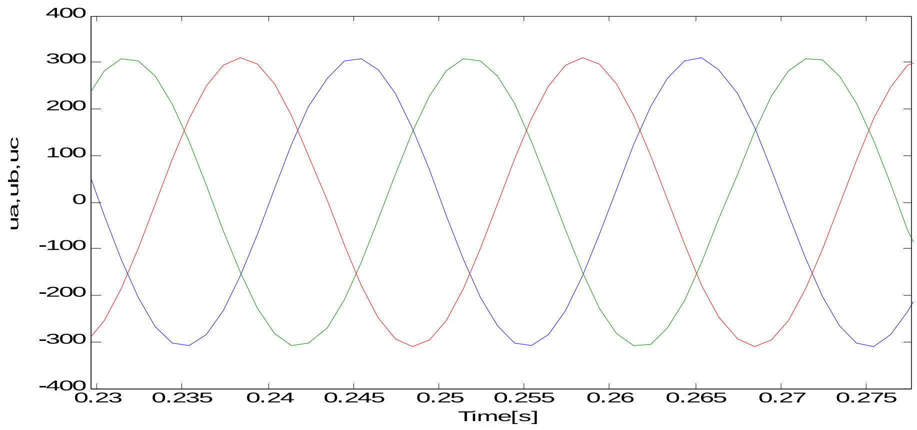


Fig.2

Three phase stator voltages when torque=39[N.m]

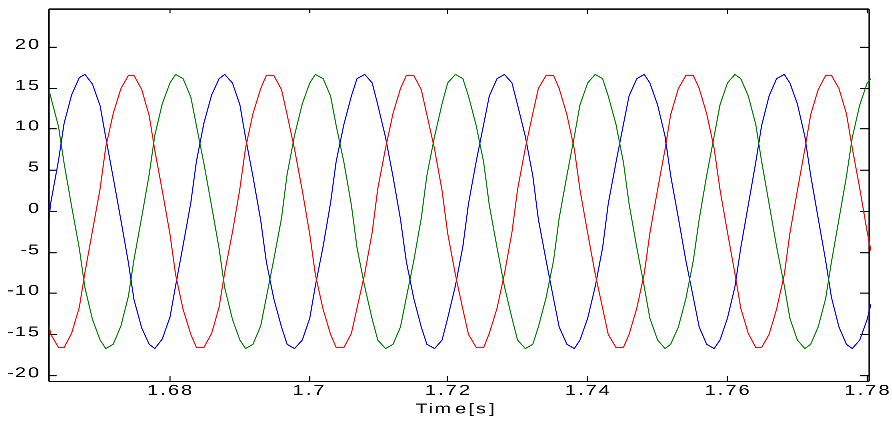


Fig.3

Three phase stator currents when torque=39[N.m]

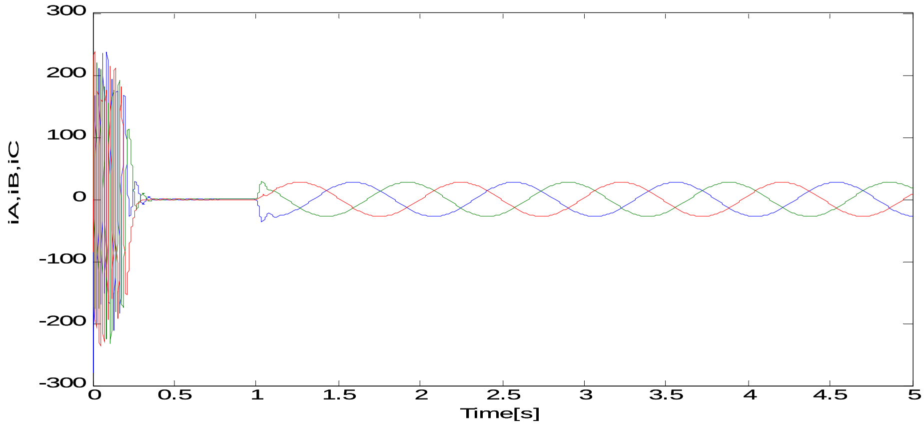


Fig.4

Three phase rotor currents when torque=39[N.m] Starting at no-load motor and at 1sec. torque is enclosed.

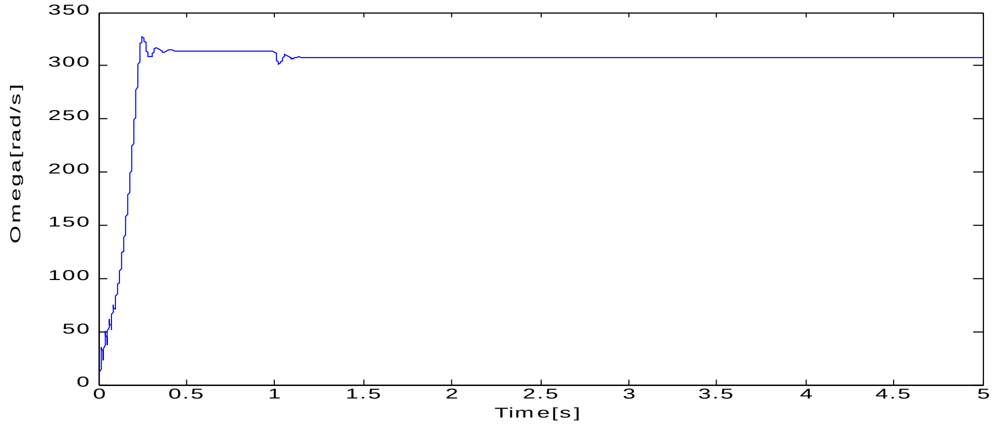


Fig.5 Motor speed when torque=39[N.m]

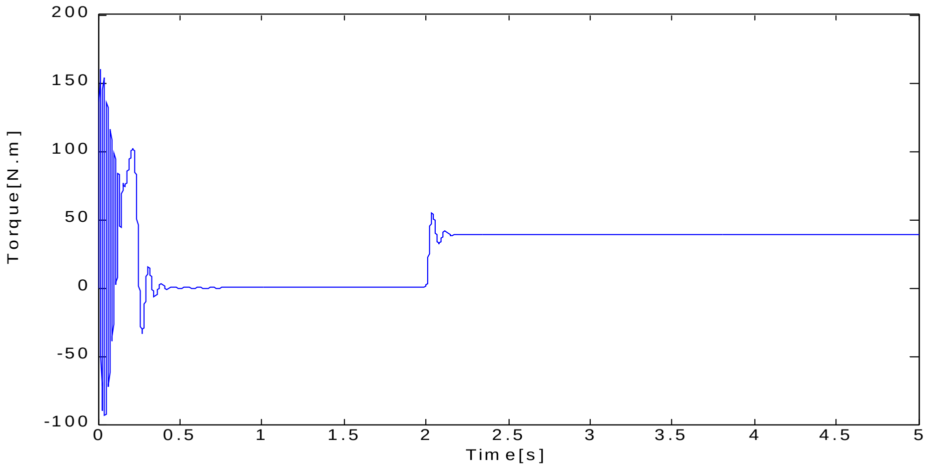


Fig.5 Motor Torque

CONCLUSION

Modeling offers great advantages in transient phenomena. The aim of this contribution was to develop a simulation environment for asynchronous motor. To achieve this, a methodology was presented for coupling of mathemetical equations (mathmetical model) with a system simulator SIMULINK. The inputs for the functional block in SIMULINK are the supply voltages, while the outputs are the above-mentioned curves.

Refrences

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