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IMPLEMENTATION ISSUES FOR ONE-STEP-AHEAD PREDICTIVE CONTROL OF AN INDUCTION MACHINE

BY

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Abstract. In this paper is presented the algorithm in pseudo-code format for one-step-ahead predictive control of induction machine. For this propose, it is developed the mathematical model of induction machine in a stationary system reference frame. The Model Predictive Control (MPC) of induction machine is a problem of cost function optimization that leads to finding the optimal switching functions of the power inverter. Electromagnetic torque and stator magnetic flux are controlled by predictive controller in the order to meet the references. The obtained results by simulation in Matlab-Simulink® environment of torque and speed confirm the desired control performances by tracking the references. It is concluded that due to the obtained performances, MPC of induction machine represents an alternative to the classical methods. The developing of algorithms for prediction in induction machine drive is a fundamental task for the modern approach by integrating and implementing of advanced control strategies.

Keywords: one-step-ahead predictive control; induction machine; switching functions; pseudo-code format; predictive controller; speed response.

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1. Introduction

Actually, an important attention is accorded to developing of electric drives with induction machine. The main advantages that recommends induction machine in such applications are (Boldea and Nasar, 2009): low cost, high torque capability, robust structure, well-developed manufactures technology with low environment impact and minimum waste of materials. As a consequence of the power converters and advanced signal processors developing, induction machine has been embedded in a large area of applications (Boldea and Nasar, 2005; Leonhard, 2001): electric drives with adjustable speed, motion control in robotics, automotive applications, electric railways, industrial process, special applications etc.

The control of induction machine has been developed by separating the flux and electromagnetic torque loops as is natural achieved at Direct Current (DC) electric machines. Nevertheless, a global theory of orthogonal models starting for synchronous machine (Park, 1929; Park 1933) and later has been developed for induction machine (Ku, 1957). A first approach of closed loop control theory of induction machine was based on magnetic flux sensors (Blaschke, 1972), called direct method. The proposed novelty is the concept of transvector theory that means the mathematical model of electric machine is oriented in a particular system reference frame aligned to magnetic flux. The highest performances were obtained for rotor magnetic flux orientation. In this case, the mathematical model of control systems is simplified and an easy-implementation control strategy may be performed (Boldea and Nasar, 2005).

In the order to eliminate the difficulties generated by using the magnetic flux sensors, which involves the increasing of costs and signal perturbation, an indirect method of field oriented control was suggested by (Hasse, 1969) and included later in closed loop applications (Matsuo and Lipo, 1985). In this case, the magnetic flux is computed with the help of stator currents and angular speed. The later works proposed a substantial improvement of the closed-loop performances that leads to using different computational techniques. Due to the large area of applications, these results become classical, and are currently used as an essential tool for modeling and control loop design (Leonhard, 2001; Quang and Dittrich, 2008). More advanced control techniques propose the elimination of mechanical sensor, the speed being estimated in so-called sensorless control methods (Vas, 1998).

A particular class of control strategy is represented by Direct Torque Control (DTC). In this case, the mathematical model of induction machine is represented in stator coordinates, the motor being non-aligned with magnetic flux. The advantage is the simplification of control scheme which are implemented with bang-bang controllers, while the drawback is the high values of the ripple of electromagnetic torque (Vas, 1998; Depenbrock, 1984).

The interface between control system and induction machine is assured by the execution element which is represented by a power inverter that is controlled by signal controllers. The output voltage is obtained based on a modulation of control signals which is designed according to different criteria (Kerkman, 1996). Due to signals processing, the usual modulation techniques are quite complex.

A survey of the control methods of Alternative Current (AC) drives, including induction machine, is represented by (Haitham *et al*., 2012). Also, there are presented additional information for user in implementation on Matlab-Simulink ® environment, which are in the current trend.

In parallel with the classic induction machine control strategy development, prediction in various processes for control systems was present in the researcher's attention (Maciejowski, 2002). From a large area of methods, a practice and deterministic method are represented by MPC (Camacho and Bordons, 2004; Rawlings and Mayne, 2009; Rossiter, 2013). Due to the fact that the mathematical model of induction machine is well-known, the MPC may be successfully applied.

A first approach of MPC of induction machine has been performed in the last decades (Kennel and Linder, 2000; Kennel and Linder, 2001; Geyer, 2005), and later improved for practical applications (Tibamoso and Oñate, 2017). May be used continuous or continuous MPC controllers (Wróbel *et al*., 2020). The benefits arise from using MPC in the induction machine drive are: optimization of both transients and steady-state regimes, avoiding the tuning of controllers as in the case of classic methods, easy-including the restriction of control signals, prediction in a predefined horizon etc.

A simplification MPC of induction machine can be developed by considering the induction machine supplied by a power inverter. The mathematical model of the inverter is built up based on six switching discrete functions, which by a linear combination may provide the command voltage of induction machine (Rodriguez and Cortes, 2012). In this case, the MPC of induction machine leads to a particular and a simple block scheme that is very useful for practice. At every time instant it is searched the optimal values of switching function that composed the desired control reference voltage. By including the mathematical model of the power inverter, the approach fits the real situation that occurs in practice, which leads to harmonic content on the output voltage of the inverter, and ripple of electromagnetic torque of induction machine. In some ways, the principle of this control strategy derives from DTC, but the major difference is that the switching state results as an optimization process, and not a forced range limitations as is used on DTC.

In recent years, an important effort is based on developing high performance systems with digital controllers. The advance of the numerical processors and digital signal technique allows a friendly implementation in both online and off-line systems. For this objective it is essential to perform numerical algorithms that may be implemented on emerging technologies.

This paper presents the implementation issue for one-step-ahead predictive control of an induction machine drive in the order to develop a predictive algorithm used for design a MPC controller of electromagnetic torque. For a general approach, it has been used the pseudo-code format that allows the using in different programming media where may be necessary. The used model of induction machine is represented in a stator reference frame of fixed coordinates. Due to the large area of facilities offered by Matlab-Simulink® environment, the written algorithm is an easy-implementation tool for control of induction machine. The MPC of induction machine is based on forward Euler discretization method that reduces the computational effort.

The paper is organized as follows. Section II presents the mathematical modeling of MPC of induction machine in orthogonal components. In Section III is developed the algorithm used for MPC of induction machine. Section IV is dedicating to presentation the simulation results performed in Matlab-Simulink®. Finally, the conclusions of the paper are shown in Section V.

2. Induction Machine Model for Predicting Future Response

The well-known mathematical model of squirrel cage induction machine in a general system reference frame is described by voltage equations (Boldea and Nasar, 2005):

$$\underline{u}_s = R_s \underline{i}_s + \frac{d\underline{\psi}_s}{dt} + j\omega_k \underline{\psi}_s , \tag{1}$$

$$0 = R_r \underline{i}_r + \frac{d\underline{\psi}_r}{dt} + j(\omega_k - \omega_e)\underline{\psi}_r , \tag{2}$$

where, the involved quantities are: $(\underline{u}_s, \underline{i}_s, \underline{\psi}_s)$ - stator voltage, current and magnetic flux space vectors; $(\underline{i}_r, \underline{\psi}_r)$ - rotor current and magnetic flux space vectors; (R_s, R_r) - stator and rotor resistances; (ω_k, ω_e) - reference frame and electric rotor speeds; *j* - imaginary vector unit (rotation operator).

Eqs. (1)-(2) may be developed by introduction the magnetic flux relationships of stator and rotor:

$$\underline{\psi}_s = L_s \underline{i}_s + L_m \underline{i}_r , \tag{3}$$

$$\underline{\psi}_r = L_r \underline{i}_r + L_m \underline{i}_s , \tag{4}$$

where: (L_s, L_r, L_m) - represents the stator, rotor and magnetising inductances, respectively.

The mathematical model of squirrel cage induction machine is completed by motion equation:

$$\tau - \tau_\ell = J\frac{d\omega}{dt}, \quad (5)$$

where the electromagnetic torque is expressed in convenient stator quantities:

$$\tau = \frac{3}{2}p_b(\underline{\psi}_s \times \underline{i}_s), \quad (6)$$

and $(\tau_\ell, J, \omega, p_b)$ - are load torque, moment of inertia, rotor speed and number of stator poles pairs.

The mathematical model of induction machine (1)-(6) is projected on stator reference frame (α, β) of fixed coordinates $(\omega_k = 0)$.

By splitting space vectors into orthogonal components, the system of Eqs. (1)-(6) becomes:

$$u_{s\alpha} = R_s i_{s\alpha} + \frac{d\psi_{s\alpha}}{dt}, \quad (7)$$

$$u_{s\beta} = R_s i_{s\beta} + \frac{d\psi_{s\beta}}{dt}, \quad (8)$$

$$0 = R_r i_{r\alpha} + \frac{d\psi_{r\alpha}}{dt} + p_b\omega\psi_{s\beta}, \quad (9)$$

$$0 = R_r i_{r\beta} + \frac{d\psi_{r\beta}}{dt} - p_b\omega\psi_{s\alpha}, \quad (10)$$

$$\psi_{s\alpha} = L_s i_{s\alpha} + L_m L_{r\alpha}, \quad (11)$$

$$\psi_{s\beta} = L_s i_{s\beta} + L_m L_{r\beta}, \quad (12)$$

$$\psi_{r\alpha} = L_r i_{r\alpha} + L_m L_{r\alpha}, \quad (13)$$

$$\psi_{r\beta} = L_r i_{r\beta} + L_m L_{r\beta}, \quad (14)$$

$$J\frac{d\omega}{dt} = \tau - \tau_\ell, \quad (15)$$

$$\tau = \frac{3}{2} p_b (\psi_{s\alpha} i_{s\beta} - \psi_{s\beta} i_{s\alpha}), \tag{16}$$

where the electric speed is replaced by mechanical one with respect the relation $\omega_e = p_b \omega$.

The interface between power sources and induction machine is assured by power inverter which converters the DC into AC voltage. Also, the inverter represents the gate between power part and the signal one of the system. It is fundamental to describe the mathematical model of the inverter in a compatible mode with control system applications. A simple and useful mathematical model is based on switching function (Leonhard, 2001), which associates to each switch a logic Boolean value. It is considered that the input voltage of power inverter, named DC-link voltage, has a constant value $U_{DC} = cst.$ Thus, for the three-phase power inverter, on every phase, denoted by (*a*,*b*,*c*), it can be defined the correspondent switching function, according to:

$$S_a = \begin{cases} 1, & if \quad S_1 \equiv on \quad and \quad S_4 \equiv off \\ 0, & if \quad S_1 \equiv off \quad and \quad S_4 \equiv on \end{cases}, \tag{17}$$

$$S_b = \begin{cases} 1, & if \quad S_2 \equiv on \quad and \quad S_5 \equiv off \\ 0, & if \quad S_2 \equiv off \quad and \quad S_5 \equiv on \end{cases}, \tag{18}$$

$$S_c = \begin{cases} 1, & if \quad S_3 \equiv on \quad and \quad S_6 \equiv off \\ 0, & if \quad S_3 \equiv off \quad and \quad S_6 \equiv onf \end{cases}, \tag{19}$$

where $S_i, i = \overline{1,6}$ represents the individual state of each switch. All the possible combination of states and their resulted space vectors are summarized in Table 1.

Table 1

Switching State Combinations and the Obtained Voltage Space Vectors

No.	Switching state combinations (S_a, S_b, S_c)	Voltage space vectors
1.	(0,0,0)	$\underline{U}_1 = 0$
2.	(1,0,0)	$\underline{U}_2 = 2/3U_{DC}$
3.	(1,1,0)	$\underline{U}_3 = 1/3U_{DC} + j\sqrt{3}U_{DC}$
4.	(0,1,0)	$\underline{U}_4 = -1/3U_{DC} + j\sqrt{3}U_{DC}$
5.	(0,1,1)	$\underline{U}_5 = -2/3U_{DC}$
6.	(0,0,1)	$\underline{U}_6 = -1/3U_{DC} - j\sqrt{3}U_{DC}$
7.	(1,0,1)	$\underline{U}_7 = 1/3U_{DC} + j\sqrt{3}U_{DC}$
8.	(1,0,1)	$\underline{U}_8 = 0$

Taking into account the vector form of the involved signals and based on (17)-(19), it can be defined a space switching function:

$$\underline{S} = \frac{2}{3}(S_a + \underline{a}S_b + \underline{a}^2 S_c), \tag{20}$$

which is similarly with the classical definition of space vector, where $\underline{a} = e^{j2\pi/3}$ is the rotation operator on the each phase of induction machine.

The output space voltage of invertor, which is the supply voltage of the induction machine, is computed as a combination of spatial switching functions and based on DC-link voltage:

$$\underline{u}_s = U_{DS}\underline{S}, \tag{21}$$

which can be represented in a explicit form:

$$\underline{u}_s = \frac{2}{3}(u_{aN} + \underline{a}u_{bN} + \underline{a}^2 u_{cN}), \tag{22}$$

where: (u_{aN}, u_{bN}, u_{cN}) - are voltage phase voltage with respect to the negative terminal of power inverter.

For a compatible representation, all quantities involved on design of the control system are represented with space vector quantities, as: voltages, currents, magnetic flux etc.

The design of predictive controller is based on the forward Euler discretization method that may approximate the first derivate, according to:

$$\left.\frac{dx(t)}{dt}\right|_{x=x[k+1]} = \frac{x[k+1] - x[k]}{T_e}, \tag{23}$$

where *x(t)* is the derivate quantity, usually space state one, and T_e is the adopted time sampling.

For practical implementation it is useful to use the matrix computation technique.

By applying the Euler discretization method on voltage Eqs. (7)-(8) and (9)-(10) and taking into account the magnetic flux Eqs. (11)-(12) and (13)-(14) results the magnetic fluxes on every time instant

$$\begin{bmatrix}\hat{\psi}_{s\alpha}(k)\\ \hat{\psi}_{s\beta}(k)\end{bmatrix} = \begin{bmatrix}\hat{\psi}_{s\alpha}(k-1)\\ \hat{\psi}_{s\beta}(k-1)\end{bmatrix} + T_e\begin{bmatrix}u_{s\alpha}(k)\\ u_{s\beta}(k)\end{bmatrix} - R_s T_e\begin{bmatrix}i_{s\alpha}(k)\\ i_{s\beta}(k)\end{bmatrix}, \tag{24}$$

$$\begin{bmatrix}\hat{\psi}_{r\alpha}(k)\\ \hat{\psi}_{r\beta}(k)\end{bmatrix} = \frac{L_r}{L_m}\begin{bmatrix}\hat{\psi}_{s\alpha}(k-1)\\ \hat{\psi}_{s\beta}(k-1)\end{bmatrix} + \begin{bmatrix}i_{s\alpha}(k)\\ i_{s\beta}(k)\end{bmatrix} + \left(L_m - \frac{L_s L_r}{L_m}\right). \tag{25}$$

If it is performed the translation with one-step -ahead k→k+1, it can be predicted the stator magnetic flux:

$$\begin{bmatrix}\psi^p_{s\alpha}(k+1)\\ \psi^p_{s\beta}(k+1)\end{bmatrix} = \begin{bmatrix}\hat{\psi}_{s\alpha}(k)\\ \hat{\psi}_{s\beta}(k)\end{bmatrix} + T_e\begin{bmatrix}u_{s\alpha}(k)\\ u_{s\beta}(k)\end{bmatrix} - R_s T_e\begin{bmatrix}i_{s\alpha}(k)\\ i_{s\beta}(k)\end{bmatrix}, \tag{26}$$

Also, from relationships (7)-(8) and (9)-(10) it can be predicted the current components

$$\begin{bmatrix}i^p_{s\alpha}(k+1)\\ i^p_{s\beta}(k+1)\end{bmatrix} = \left(1+\frac{T_s}{T_t}\right)\begin{bmatrix}i_{s\alpha}(k)\\ i_{s\beta}(k)\end{bmatrix} + \frac{T_s}{T_t+T_s}\left\{\frac{1}{R_t}\left[\frac{k_r}{T_r}\begin{bmatrix}\hat{\psi}_{s\alpha}(k)\\ \hat{\psi}_{s\beta}(k)\end{bmatrix} + k_r\omega\begin{bmatrix}\hat{\psi}_{s\alpha}(k)\\ -\hat{\psi}_{s\beta}(k)\end{bmatrix} + \begin{bmatrix}u_{s\alpha}(k)\\ u_{s\beta}(k)\end{bmatrix}\right]\right\}, \tag{27}$$

where the constants used are: $T_s = L_s / R_s$, $T_r = L_r / R_r$, $k_s = L_m / L_s$, $k_r = L_m / L_r$, $T_t = \gamma L_s / R_t$, $\gamma = 1 - 1/(L_s L_r)$ and $R_t = R_s + R_r k_r^2$.

From relationships (16) and (26)-(27), it can be predicted the electromagnetic torque by:

$$\tau^p(k+1) = \frac{3}{2} p_b(\psi^p_{s\alpha} i^p_{s\beta} - \psi^p_{s\beta} i^p_{s\alpha}). \tag{28}$$

3. One-Step-Ahead Predictive Control Algorithm for an Induction Machine

The predictive control of electromagnetic torque is achieved from the extreme condition of cost function (Rodriguez and Cortes, 2012):

$$\min_{(S_a, S_b, S_c)} g, \tag{29}$$

subject to:

$$g = \left\| \tau^* - \tau^p(k+1) \right\| + \lambda_\psi \left\| \psi_s^* - \psi_{s,\alpha\beta}^p(k+1) \right\|, \tag{30}$$

where the weighed factor:

$$\lambda_\psi = \tau_n / \psi_{sn}, \tag{31}$$

is definite with the rated values of electromagnetic torque and magnetic flux.

In the block diagram of the predictive control of induction machine, presented in Fig. 1, there are used some simplified notation.

For a proper operation it is essential that the capacitor *C* is selected to a high value in the order to assure a constant DC-link voltage $U_{DC} = cst.$.

Also, there are represented all the quantities that acts on the shaft of machine: load torque, electromagnetic torque and speed.

The outer speed loop is similarly with that from classical methods, controlled by a common Proportional Integral (PI) controller. There are significant differences on electromagnetic torque and stator magnetic flux loops which are replaced with MPC algorithm developed, in details, in the next section.

It can be notated that the operation of induction machine is performed on constant stator magnetic flux, thus the speed does not exceed the rated one.

The algorithm of predictive control of induction machine on one-step-ahead prediction horizon reunites three blocks from Fig. 1: *Estimation of stator and rotor magnetic flux*, *Prediction of electromagnetic torque and stator magnetic flux* and *Minimization of cost function*.

For implementation it has been used some of the facilities offered by Matlab-Simulink ® environment, where are developed subroutines for matrix and complex quantities computing (Rodriguez and Cortes, 2012).

It has been used a simplified traditional notation for digital computing, which replace de time step notation kT_e. with k.

The predictive algorithm in pseudo-code format is presented in *Algorithm 1*, where are described step by step the statements required for practical implementation.

On every time instant the algorithm is designed to take a decision by selecting the optimal state of switching.

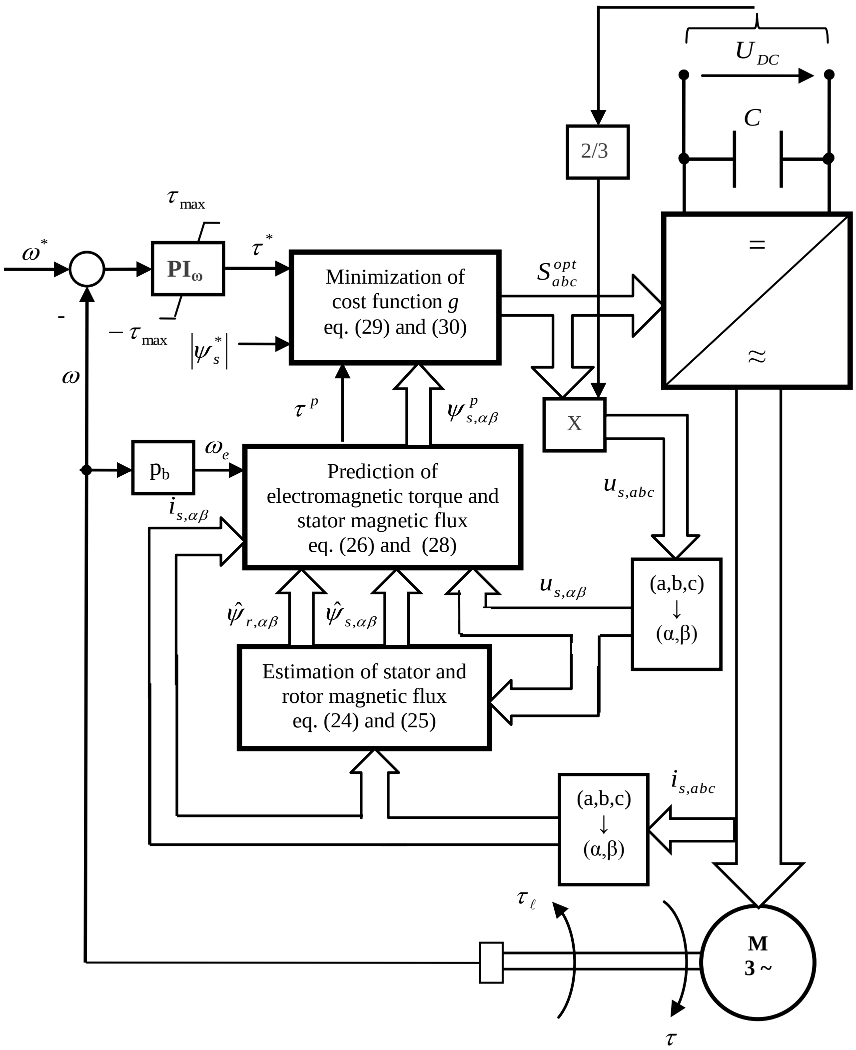

Fig. 1 – Block diagram of the one-step-ahead predictive control of induction machine.

Algorithm 1. Pseudocode for one-step-ahead predictive control of induction machine

Input: $\tau^*, \psi_s^*, \omega^*, i_s^k, u_s^k, \hat{\psi}_s^{k-1}, g_\varepsilon$ /* imposed, measured quantities and g_ε is the allowed cost function error */

Output: (S_a, S_b, S_c) /* optimal values of */

/* Build-up the states and the corresponding voltage vectors of inverter */

S← [0 0 0; 1 0 0; 1 1 0; 0 1 0; 0 1 1; 0 0 1; 1 0 1; 1 1 1] /* define and loading of all the possible combination states of switching */

u← [U_1 U_2 U_3 U_4 U_5 U_6 U_7 U_8] /* define voltage spatial vectors of inverter */

for x = 1: 8 **do** /* x is the index used for searching in the voltage table */

u(x) ← x / * vectorization of the voltage vectors of inverter */

/* Estimation */

$\psi_s^k(x) \leftarrow \psi_s^{k-1} + T_s \cdot u(x) - R_s \cdot T_s \cdot i_s^k$ /* estimation of stator magnetic flux */

$\psi_r^k(x) \leftarrow (L_r / L_m) \cdot \psi_s^{k-1} + (L_m - (L_s L_r / L_m)) \cdot i_s^k$ /* estimation of rotor magnetic flux*/

/* Prediction */

$\psi_s^{k+1}(x) \leftarrow \psi_s^k + T_s \cdot u(x) - R_s \cdot T_s \cdot i_s^k$ /* prediction of magnetic flux */

$i_s^{k+1}(x) \leftarrow (1 + T_e / T_s) i_s^k + T_e / (1/T_t + T_s) \cdot (1/R_t)((k_r / T_r - k_r j\omega)\psi_s^{k+1}(x) + u(x)$ /* prediction of stator current */

$\tau^{k+1}(x) = 3/2 \cdot p_b(\psi_{s\alpha}^{k+1}(x) i_{s\beta}^{k+1}(x) - \psi_{s\beta}^{k+1}(x) i_{s\alpha}^{k+1}(x))$ /* prediction of electromagnetic torque, it were used the stator quantities expressed in stator coordonates */

$g(x) = norm(\tau^* - \tau^{k+1}(x)) + \lambda_\psi norm(\psi_s^* - \psi_s^{k+1}(x))$ /* cost function */

/* Searching the optimum index of the voltage vectors of inverter */

  if $g(x) < g_\varepsilon(x)$ **then**

    $g_{opt} \leftarrow g(x)$

    $x_{opt} \leftarrow x$

  end if

end for

/* Find the optimal functions values of switching state */

$[S_a \quad S_b \quad S_c]_{opt} \leftarrow S(x_{opt}, :)$ /* optimal switching functions obtained by extraction the x_{opt}^{th} line of matrix S */

$u^{k+1} \leftarrow u(x_{opt})$ /* predicted voltage of inverter, it is not necesary, but can be evaluated */

return: $[S_a \quad S_b \quad S_c]_{opt}$ /* optimal switching functions */

As input quantities, there are considered: references for speed, electromagnetic torque and stator magnetic flux; stator current, voltage current al actual time sampling k; stator magnetic flux at time sampling *k-1*; the allowed cost function error g_ε. The cost function error has a small value, and is imposed due to the fact that in practice the output voltage of inverter is based on discrete values of switching, which leads to some small differences besides the continuous computing.

Further, it is searched the index which leads to optimization problem. This index is crucial for searching the optimal functions values of switching which are outputs of the algorithm.

This process of searching the optimal switching state is applied on every time sampling, therefore it is powerful dependent of the value of time instant.

4. Numerical Simulations

In the order to check the theoretical background and the algorithm presented in the previous sections, in this section it is performed a case study of numerical simulation of one-step-ahead predictive control technique of an induction machine in Matlab-Simulink environment.

Thus, the imposed ramp speed profile ω^* and the response one ω (actual value) are depicted in Fig. 2. It can be noted that the control system has a good response in both transient and steady-state regime, with null steady-state tracking error.

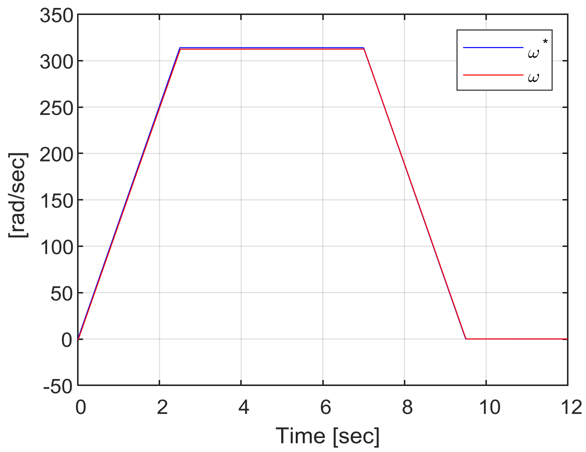

Fig. 2 − The controlled speed of induction machine.

Rejection of perturbation represented by load torque is presented in Fig. 3. The load torque τ_ℓ has the profile specific to an electric vehicle (composed by a constant term and a quadratic-speed one).

The other quantities represented are: electromagnetic torque reference τ^* and electromagnetic torque response τ . From figure it can be observed that the MPC system has the property to reject the perturbation by tracking the electromagnetic torque reference.

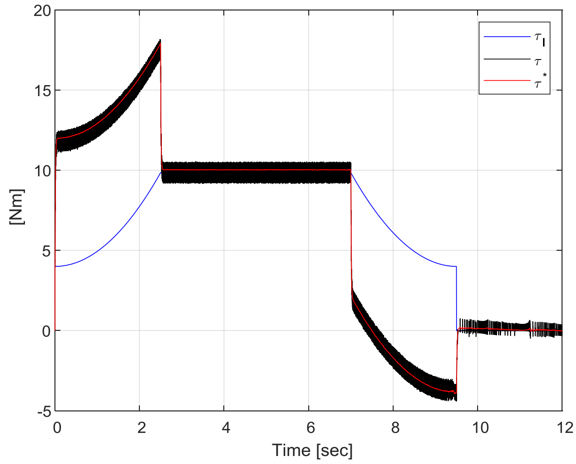

Fig. 3 – Rejection of perturbation by electromagnetic torque tracking.

Although the system has a hybrid structure involving continuous and digital models, it can be quantitatively appreciated that the operation remains stable even under the occurring perturbations. In this case, the stability of the system is indirectly ensured by the selected pattern of the switching function combination that leads to generate the optimal command.

4. Conclusions

Predictive control of induction machine provides an alternative to classical methods. A particular control strategy, represented by MPC, leads to high successful in practical implementation. The designed algorithm for MPC of induction machine is fundamental for programming the control system tracking.

A major benefit arose by using MPC of induction machine is elimination of the frequency modulation of the inverter, which leads to a very fast transient response and thus avoiding the delays introduced by this device.

The obtained results are promising for future work, which involve the researching the possibility of prediction on multiple-step-ahead horizon in the order to improve the actual obtained performances. Also, it can be designed load torque and speed estimator for adapting the control scheme to practical requirements. More advanced techniques, based on MPC, may be embedded in the order to meet the current exigencies.

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PARTICULARITĂŢI DE IMPLEMENTARE NUMERICĂ A CONTROLULUI PREDICTIV PE UN PAS LA MAŞINA ASINCRONĂ

(Rezumat)

În această lucrare este prezentat algoritmul de control predictiv pe un orizont de un pas în format pseudo-cod pentru reglarea vitezei mașinii asincrone. Îndeplinirea acestui obiectiv se realizează pe baza modelului ortogonal al mașinii asincrone reprezentat într-un sistem fix de coordonate statorice. Reglarea predictivă a maşinii asincrone este o problemă de optimizare a funcției de cost, care conduce la găsirea funcțiilor optime de comutaţie ale invertorului de putere. Cuplul electromagnetic și fluxul statoric magnetic sunt reglate de un regulator predictive, care permite urmărirea referințelor impuse. Rezultatele obținute prin simulare în mediul Matlab-Simulink® ale cuplului și vitezei confirmă performanțele de control impuse. Se concluzionează că datorită performanțelor obținute, regulatoarele predictive reprezintă o alternativă la cele clasice în vederea conducerii mașinii de inducție. Dezvoltarea algoritmilor de reglare predictivă în acționările electrice cu mașină asincronă, reprezintă o abordarea modernă ce permite integrarea și implementarea strategiilor avansate de reglare.