TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics and Mechanics
Vol. 54, Issue IV, 2011

CONTRIBUTIONS TO THE DYNAMICS OF MOBILE ROBOT PATROLBOT

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Abstract: *In keeping with the fact that the robots during operations are performing moving trajectories situated in the configuration space, or in the Cartesian space, it's imposed a continuous control of kinematic parameters and respectively the generalized force from every driving joint, in order to achieve a proper control of the dynamic parameters. In keeping with this, the purpose of the paper is to determine the dynamic equations for the mobile robot PatrolBot. The motion equations will be determined on the basis of the new concepts in advanced mechanics, such as Variational Principles in Analytical Mechanics, concerning the acceleration energy, part of important scientific researches deployed by the main author.*

Key words: *mobile robot, variational principles, motion trajectory, control, acceleration energy.*

1. INTRODUCTION

In the paper will be analyzed the dynamics of the mobile robot structure called PatrolBot, which is a product of the American company Mobile Robots Inc., located in the laboratory "Mechanics of Advanced Robotics", in the Department of Mechanics and Programming, from Technical University of Cluj-Napoca. The mobile platform is a system able to integrate in a fairly wide class of general applications [1].

Fig 1 The mobile robot PatrolBot

PatrolBot structure has two independent driving wheels and two driven wheels, so it is included in class mobile systems with differential orientation. The robot executes a plan-parallel movement so in the configuration space, each of the three movements are parallel and independent each other. In this feature, it appears that mobile robot cannot move laterally with a speed that is transverse to the axis of the wheels; this constraint is called nonholonomous constraint. Hence, the robot can reach any position and orientation, moving forward or backward, followed by a rotation around its central axis [2], [3].

2. THE DYNAMICS OF MOBILE PLATFORM PATROLBOT

In keeping with the Fig.2, the kinematical differential restrictions of the platform are presented in accordance with the Table 1.

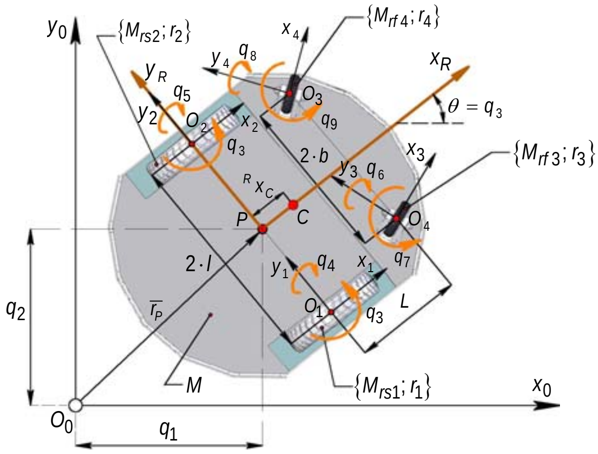

Fig.2 The independent parameters of PatrolBot in finite displacements

Table 1

$-sq_3 \cdot dq_1 + cq_3 \cdot dq_2 = 0$	(1)
$cq_3 \cdot dq_1 + sq_3 \cdot dq_2 + l \cdot dq_3 - r_{rs} \cdot dq_4 = 0$	(2)
$cq_3 \cdot dq_1 + sq_3 \cdot dq_2 - l \cdot dq_3 - r_{rs} \cdot dq_5 = 0$	(3)
$-s(q_3 + q_7) \cdot dq_1 + c(q_3 + q_7) \cdot dq_2 + +(L \cdot cq_7 - b \cdot sq_7) \cdot dq_3 = 0$	(4)
$-s(q_3 + q_9) \cdot dq_1 + c(q_3 + q_9) \cdot dq_2 + +(L \cdot cq_9 + b \cdot sq_9) \cdot dq_3 = 0$	(5)
$c(q_3 + q_7) \cdot dq_1 + s(q_3 + q_7) \cdot dq_2 + +(L \cdot sq_7 + b \cdot cq_7) \cdot dq_3 - r_{rf} \cdot dq_6 = 0$	(6)
$c(q_3 + q_9) \cdot dq_1 + s(q_3 + q_9) \cdot dq_2 + +(L \cdot sq_9 - b \cdot cq_9) \cdot dq_3 + -r_{rf} \cdot dq_8 = 0$	(7)

In the previous expressions from Table 1, there have been introduced the following notations: $\{cq_i = \cos cq_i\,;\, sq_i = \sin cq_i, i = 1 \to n\}$. The moving differential equations for any mechanical system can be obtained by means of the D'Alembert-Lagrange principle considered as fundamental equation in the study of the dynamics of mechanical systems with links. In the study, to determine the dynamic equations of the serial structure there are used fundamental notions of advanced mechanics like acceleration energy, [2], [3] [4] which is integrated in the following, expressed:

$$\frac{\partial E_A}{\partial \ddot{q}_i} + Q_g^i + Q_{SU}^i = Q_m^i\left(\bar{\theta}; \dot{\bar{\theta}}; \ddot{\bar{\theta}}\right) \qquad (1)$$

where, Q_{SU} is the generalized handling force, Q_g^i and Q_m^i are generalized gravitational and generalized driving forces, which are characterizing every driving joint of the general robot structure. The expression (1) presented above, represents a generalization of the variational principle based on acceleration energy which is further used for determining the differential equations of motion for any type of mechanical robot structure. In relations (1) the term $E_A^i(q_k; \dot{q}_k; \ddot{q}_k)$ represents the following [4]:

$$\begin{aligned} E_A^i(q_k; \dot{q}_k; \ddot{q}_k) &= \frac{1}{2} \cdot M_i \cdot {}^i\dot{\bar{v}}_{C_i}^T \cdot {}^i\dot{\bar{v}}_{C_i} + \\ &+ \frac{1}{2} \cdot \left\{ {}^i\dot{\bar{\omega}}_i^T \cdot {}^iI_i^* \cdot {}^i\dot{\bar{\omega}}_i + \left[{}^i\bar{\omega}_i \times {}^iI_i^* \cdot {}^i\bar{\omega}_i \right] \right\} + \\ &+ \frac{1}{2} \cdot {}^i\dot{\bar{\omega}}_i^T \cdot \left[{}^i\bar{\omega}_i \times {}^iI_i^* \cdot {}^i\bar{\omega}_i \right] + \\ &+ \frac{1}{2} \cdot \bar{\omega}_i^T \cdot \left[{}^i\bar{\omega}_i^T \cdot Tr\left({}^iI_{pi}\right) \cdot {}^i\bar{\omega}_i - {}^i\bar{\omega}_i^T \cdot {}^iI_{pi} \cdot {}^i\bar{\omega}_i \right] \cdot {}^i\bar{\omega}_i \end{aligned} \qquad (2)$$

The generalized expression (2) represents the acceleration energy for any robot kinetic link, where M_i is the mass corresponding to each kinetic link of the robot, ${}^iI_i^*$ which is the axial centrifugal inertia tensor and ${}^iI_{pi}$ the inertia tensor planar centrifugal that characterizes the entire kinetic assembly(i), relative to the frame$\{i\}$, applied in the mass center of each linkC_i. In the same expression, ${}^i\bar{v}_{C_i}$ and ${}^i\dot{\bar{v}}_{C_i}$ are the velocity and the acceleration of mass center, ${}^i\bar{\omega}_i$ and ${}^i\dot{\bar{\omega}}_i$ are the angular velocity and acceleration of the kinetic link (i) relative to the moving frame $\{i\}$ attached to the robot. Using as fundamental expression [4], the relation (2), the expression of acceleration energy for mobile platform PatrolBot is [5]:

$$\begin{aligned} E_A^{tot} = \; & \frac{M_{rs}}{2} \cdot \left[\begin{aligned} &\left(\ddot{q}_1 + l \cdot \ddot{q}_3 \cdot cq_3 - l \cdot \dot{q}_3^2 \cdot sq_3\right)^2 + \left(\ddot{q}_2 + l \cdot \ddot{q}_3 \cdot sq_3 + l \cdot \dot{q}_3^2 \cdot cq_3\right)^2 + \\ &+ \left(\ddot{q}_1 - l \cdot \ddot{q}_3 \cdot cq_3 + l \cdot \dot{q}_3^2 \cdot sq_3\right)^2 + \left(\ddot{q}_2 - l \cdot \ddot{q}_3 \cdot sq_3 - l \cdot \dot{q}_3^2 \cdot cq_3\right)^2 \end{aligned} \right] + \\ & + \frac{M_{rs} \cdot r_{rs}^2}{4} \cdot \left(\ddot{q}_4^2 + \ddot{q}_3^2 + \dot{q}_4^4 + \dot{q}_3^4 + \frac{3}{2} \cdot \dot{q}_3^2 \cdot \dot{q}_4^2 + \ddot{q}_5^2 + \dot{q}_5^4 + \frac{3}{2} \cdot \dot{q}_3^2 \cdot \dot{q}_5^2 \right) + \\ & + \frac{M_{rf}}{2} \cdot \left\{ \left[\ddot{q}_1 - L \cdot \left(\ddot{q}_3 \cdot sq_3 + \dot{q}_3^2 \cdot cq_3\right) + b \cdot \left(\ddot{q}_3 \cdot cq_3 - \dot{q}_3^2 \cdot sq_3\right) \right]^2 + \right. \\ & + \left[\ddot{q}_2 + L \cdot \left(\ddot{q}_3 \cdot cq_3 - \dot{q}_3^2 \cdot sq_3\right) + b \cdot \left(\ddot{q}_3 \cdot sq_3 + \dot{q}_3^2 \cdot cq_3\right) \right]^2 + \\ & + \left[\ddot{q}_1 - L \cdot \left(\ddot{q}_3 \cdot sq_3 + \dot{q}_3^2 \cdot cq_3\right) - b \cdot \left(\ddot{q}_3 \cdot cq_3 - \dot{q}_3^2 \cdot sq_3\right) \right]^2 + \\ & \left. + \left[\ddot{q}_2 + L \cdot \left(\ddot{q}_3 \cdot cq_3 - \dot{q}_3^2 \cdot sq_3\right) - b \cdot \left(\ddot{q}_3 \cdot sq_3 + \dot{q}_3^2 \cdot cq_3\right) \right]^2 \right\} + \\ & + \frac{M_{rf} \cdot r_{rf}^2}{4} \cdot \left(\ddot{q}_6^2 + \frac{1}{2} \cdot \ddot{q}_7^2 + \dot{q}_6^4 + \frac{1}{2} \cdot \dot{q}_7^4 + \frac{3}{2} \cdot \dot{q}_6^2 \cdot \dot{q}_7^2 + \ddot{q}_8^2 + \frac{1}{2} \cdot \ddot{q}_9^2 + \dot{q}_8^4 + \frac{1}{2} \cdot \dot{q}_9^4 + \frac{3}{2} \cdot \dot{q}_8^2 \cdot \dot{q}_9^2 \right) + \\ & + \frac{1}{2} \cdot M \cdot \left(\ddot{q}_1^2 + \ddot{q}_2^2\right) - M \cdot {}^Rx_C \cdot \ddot{q}_3 \cdot (\ddot{q}_1 \cdot sq_3 - \ddot{q}_2 \cdot cq_3) - \\ & - M \cdot {}^Rx_C \cdot \dot{q}_3^2 \cdot (\ddot{q}_1 \cdot cq_3 + \ddot{q}_2 \cdot sq_3) + \frac{1}{2} \cdot I_{\Delta P} \cdot \left(\ddot{q}_3^2 + \dot{q}_3^4\right) \end{aligned} \qquad (3)$$

where, $\{q_j; j = 1 \to 9\}$ represents the generalized coordinates, $\lambda_i; i = 1 \to 7$ are the undetermined Lagrange parameters, ${}^Rx_C$ is the mass center of the mobile robot, and $I_{\Delta P}$ represents the inertia moment with respect to C_z axis. In the same expression, M_{rs} and M_{rf} are the masses of the back and front wheels; r_{rs} and r_{rf} are the radii of the wheels, and M is the total mass of the mobile structure PatrolBot [2]. The differential moving expression of mobile robot PatrolBot are as presented in Table 2.

Table 2

$M \cdot \ddot{q}_1 - \left(\ddot{q}_3 \cdot sq_3 + \dot{q}_3^2 \cdot cq_3\right)\cdot\left(M_{pl} \cdot {}^R x_C + 2 \cdot M_f \cdot L\right) = = -\lambda_1 \cdot sq_3 + cq_3 \cdot (\lambda_2 + \lambda_3) - \lambda_4 \cdot s(q_3 + q_7) - -\lambda_5 \cdot s(q_3 + q_9) + \lambda_6 \cdot c(q_3 + q_7) + \lambda_7 \cdot c(q_3 + q_9)$	(1)
$M \cdot \ddot{q}_2 + \left(\ddot{q}_3 \cdot cq_3 - \dot{q}_3^2 \cdot sq_3\right)\cdot\left(M_{pl} \cdot {}^R x_C + 2 \cdot M_f \cdot L\right) = = \lambda_1 \cdot cq_3 + sq_3 \cdot (\lambda_2 + \lambda_3) + \lambda_4 \cdot c(q_3 + q_7) + \lambda_5 \cdot c(q_3 + q_9) + +\lambda_6 \cdot s(q_3 + q_7) + \lambda_7 \cdot s(q_3 + q_9)$	(2)
$\ddot{q}_3 \cdot \left[I_{\Delta P} + 2 \cdot M_{rf} \cdot \left(b^2 + L^2\right)\right] - -\left(M_{pl} \cdot {}^R x_C + 2 \cdot M_{rf} \cdot L\right)\cdot(\ddot{q}_1 \cdot sq_3 + \dot{q}_1 \cdot \dot{q}_3 \cdot cq_3 - \ddot{q}_2 \cdot cq_3 + \dot{q}_2 \cdot \dot{q}_3 \cdot sq_3) + +\dot{q}_3 \cdot \left(M_{pl} \cdot {}^R x_C + 2 \cdot M_{rf} \cdot L\right)\cdot(\dot{q}_1 \cdot cq_3 + \dot{q}_2 \cdot sq_3) = = l \cdot (\lambda_2 - \lambda_3) + \lambda_4 \cdot (L \cdot cq_7 - b \cdot sq_7) + +\lambda_5 \cdot (L \cdot cq_9 + b \cdot sq_9) + \lambda_6 \cdot (L \cdot sq_7 + b \cdot cq_7) + \lambda_7 \cdot (L \cdot sq_9 - b \cdot cq_9)$	(3)
$\frac{M_{rs} \cdot r_{rs}^2}{2} \cdot \ddot{q}_4 + Q_f^{rs} \cdot \mathrm{sgn}(\dot{q}_4) = Q_m^4 - \lambda_2 \cdot r_{rs}$	(4)
$\frac{M_{rs} \cdot r_{rs}^2}{2} \cdot \ddot{q}_5 + Q_f^{rs} \cdot \mathrm{sgn}(\dot{q}_5) = Q_m^5 - \lambda_3 \cdot r_{rs}$	(5)
$\frac{M_{rf} \cdot r_{rf}^2}{2} \cdot \ddot{q}_6 + Q_f^{rf} \cdot \mathrm{sgn}(\dot{q}_6) = -\lambda_6 \cdot r_{rf}$	(6)
$\frac{M_{rf} \cdot r_{rf}^2}{2} \cdot \ddot{q}_8 + Q_f^{rf} \cdot \mathrm{sgn}(\dot{q}_8) = -\lambda_7 \cdot r_{rf}$	(7)
$\frac{M_{rf} \cdot r_{rf}^2}{4} \cdot \ddot{q}_7 + Q_f^7 \cdot \mathrm{sgn}(\dot{q}_7) = 0$	(8)
$\frac{M_{rf} \cdot r_{rf}^2}{4} \cdot \ddot{q}_9 + Q_f^9 \cdot \mathrm{sgn}(\dot{q}_9) = 0$	(9)

The moving of the mobile structure should be studied considering the fact that the structure, to achieve the target point, cannot simultaneous do a positioning (translation) and an orientation, so the two movements will be analyzed independently [5].

3. DETERMINING OF PATROLBOT`S WHEELS DRIVING MOMENTS

The dynamics equations presented above are highlighting the complexity of the dynamic control. In order to express the dynamic control functions of the mobile structure, on an established trajectory, the actuating motors must overlap the generalized forces , as inertial forces, or gravitational forces (of the handled object). The moving of the structure has to be analyzed in keeping with the fact that the robot PatrolBot, due to its structure in order to achieve the goal point can`t realize simultaneous a translation and a orientation, hence the two displacements will be analyzed independently. Hence, to realize a straight line motion, according to its design, an essential condition is that the driving moments of the wheels must be equal $\{Q_m^4 = Q_m^5\}$, so in keeping with this it can be deduced that [5]:

$$\left\{(\ddot{q}_4 = \ddot{q}_5),\ q_3 = cst.,\ (\dot{q}_3, \ddot{q}_3) = 0,\ (\ddot{q}_6 = \ddot{q}_8),\ (q_7, q_9) = 0\right\} \quad (4)$$

According to Table 2, it can be seen that, $(\lambda_2 = \lambda_3)$ respectively $(\lambda_6 = \lambda_7)$.There it is introduced the notation:

$$\varepsilon_P = \ddot{q}_{4,5} = \left\{\frac{1}{\cos q_3} \cdot \frac{\ddot{q}_1}{r_{rf}},\ \frac{1}{\sin q_3} \cdot \frac{\ddot{q}_2}{r_{rf}}\right\} \quad (5)$$

with the observation that $\{\varepsilon_P\}$ takes the first form from (5) in the case of translation along q_1, respectively the value of the second term in the case of displacement along q_2. The expressions of the driving moment of the robot PatrolBot in order to realize a translation are:

$$Q_m^4 = Q_m^5 = \frac{r_{rs}}{2} \cdot \left[M \cdot (\ddot{q}_1 \cdot cq_3 + \ddot{q}_2 \cdot sq_3) + + \varepsilon_P \cdot (M_{rf} \cdot r_{rf} + M_{rs} \cdot r_{rs}) + \mu \cdot M \cdot g\right] \quad (6)$$

To realize the orientation, the following condition has to be accomplished $\{Q_m^4 = -Q_m^5\}$. The conditions for orientation of the mobile robot PatrolBot are:

$$\left\{(q_1, q_2) = cst.,\ (\dot{q}_1, \dot{q}_2) = 0,\ (\ddot{q}_1, \ddot{q}_2) = 0\right\} \quad (7)$$

This in keeping with the restriction conducts to:

$$\left\{(\ddot{q}_5 = -\ddot{q}_4),\ (\ddot{q}_6 = \ddot{q}_8)\right\}$$
$$\left\{(-\lambda_2 = \lambda_3),\ (\lambda_6 = \lambda_7)\right\} \quad (8)$$

After a few transformations, there are obtained the expressions of the driving moments for the two wheels in the case of orientation, as having the following form:

$$Q_m^4 = -Q_m^5 = \left[\frac{I_{\Delta P} + 2 \cdot M_{rf} \cdot \left(b^2 + L^2\right)}{2 \cdot l} + M_{rf} \cdot \frac{L^2 + b^2}{2 \cdot l} + + M_{rs} \cdot \frac{l}{2}\right] \cdot r_{rs} \cdot \ddot{q}_3 + \frac{\mu \cdot M \cdot g \cdot r_{rs}}{2 \cdot \left[\mu \cdot (r_{rf} - r_{rs}) + L\right]} \cdot Q_m^s \quad (9)$$

where $Q_m^s = \left[\left({}^R x_C - \mu r_{rs}\right) \cdot \frac{\sqrt{L^2 + b^2}}{l} + \left(L - {}^R x_C + \mu r_{rf}\right)\right]$.

The relations (6) and (9) are representing the expressions of the driving moments of the mobile robot wheels. Analyzing the above expressions, it can be seen that the final form of the driving moments containing a static and a dynamic component.

4. THE WORKING PROCESS OF THE MOBILE ROBOT PATROLBOT

Further is considered a working process, presented in Fig.3, where is integrated the mobile platform PatrolBot. The process contains $(j=1\rightarrow 9)$ working sequences, consisting in five translations and four orientations.

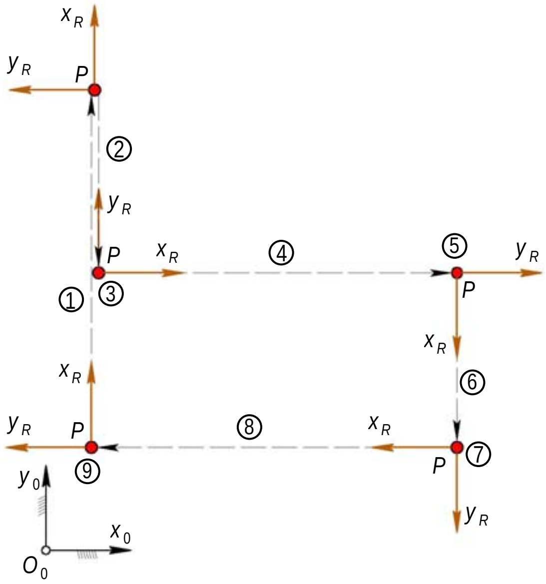

Fig.3 The working process imposed to PatrolBot

Further, from the working process of the mobile robot described by Fig. 3, will be presented the sequences $(j=1,3)$, which are representing a translation (q_2), and an orientation (q_3) with $\varphi=-\pi/2$.

4.1. Polynomial functions of $(3n)$ type with restrictions

The interpolating functions are consisting in generation of linear functions with respect to time for generalized accelerations from every driving joint belonging to the robot. According to [4], [5] it is generated a linear function with respect to time as follows:

$$\ddot{q}_{ji}(\tau) = \frac{\tau_i-\tau}{t_i}\cdot\ddot{q}_{ji}(\tau_{i-1}) + \frac{\tau-\tau_{i-1}}{t_i}\cdot\ddot{q}_{ji}(\tau_i) \quad (10)$$

where $t_i=\tau_i-\tau_{i-1}$ represents the duration of each $(i=1\rightarrow 3)$ segment of the trajectory.

The unknowns for the generalized accelerations at τ_{i-1} and τ_i are defined as:

$$\ddot{q}_{ji}(\tau_{i-1}) = \ddot{q}_{ji-1}\,;\quad \ddot{q}_{ji}(\tau_i) = \ddot{q}_{ji}\,. \quad (11)$$

After a few transformations, are obtained the functions for generalized velocities and coordinations as shown:

$$\dot{q}_{ji}(\tau) = -\frac{(\tau_i-\tau)^2}{2\cdot t_i}\cdot\ddot{q}_{ji-1} + \frac{(\tau-\tau_{i-1})^2}{2\cdot t_i}\cdot\ddot{q}_{ji} + \left(\frac{q_{ji}}{t_i}-\frac{t_i}{6}\cdot\ddot{q}_{ji}\right) - \left(\frac{q_{ji-1}}{t_i}-\frac{t_i}{6}\cdot\ddot{q}_{ji-1}\right) \quad (12)$$

$$q_{ji}(\tau) = \frac{(\tau_i-\tau)^3}{6\cdot t_i}\cdot\ddot{q}_{ji-1} + \frac{(\tau-\tau_{i-1})^3}{6\cdot t_i}\cdot\ddot{q}_{ji} + \left(\frac{q_{ji}}{t_i}-\frac{t_i}{6}\cdot\ddot{q}_{ji}\right)\cdot(\tau-\tau_{i-1}) + \left(\frac{q_{ji-1}}{t_i}-\frac{t_i}{6}\cdot\ddot{q}_{ji-1}\right)\cdot(\tau_i-\tau) \quad (13)$$

The input parameters for study are presented as follows in the Table 3:

Table 3

Seq. $j=1\rightarrow 9$	Config. k=0→27	Time $\tau_{jk}\langle s\rangle$	Duration $t_i\langle s\rangle$	Coordinates values $q_{jk}\langle m,rad\rangle$
1	0	0	0	0
	1	2	2	
	2	4	2	
	3	6	2	2
3	6*	18	0	1,571
	7	18,5	0,5	
	8	18,75	0,25	
	9	19,25	0,5	0

On the basis of the parameters presented in Table 3 in keeping with (11)-(13), are determined the expressions for coordinates, velocities and accelerations as in Table 4:

Table 4

Secq. i=1→9	Interval i=1→3	Coord.*	Expressions for generalized coordinates, velocities and accelerations q_{jk} $\langle m,rad\rangle$	$\dot{q}_{jk}$ $\dot{q}_{jk}\langle m/s, rad/$	$\ddot{q}_{jk}$ $\dot{q}_{jk}\langle m/s^2, rad/s^2\rangle$
1	1	q_2	$0{,}0417\cdot\tau^3$	$0{,}125\cdot\tau^2$	$0{,}25\cdot\tau$
	2		$-0{,}1\cdot\tau^3+0{,}75\cdot\tau^2$ $-1{,}5\cdot\tau+1$	$-0{,}25\cdot\tau^2+1{,}5\cdot($	$1{,}5 - 0{,}5\cdot\tau$
	3		$0{,}0417\cdot(\tau-6)^3+$	$0{,}125\cdot(\tau-6)^2$	$0{,}25\cdot\tau - 1{,}5$
3	1	q_3	$1{,}571-3{,}351\cdot(\tau-$	$-10{,}053\cdot(\tau-18)^2$	$-10{,}1\cdot(2\tau - 36)$
	2		$13{,}4\cdot\tau^3-748{,}9\cdot$ $+13945{,}7\cdot\tau-865$	$40{,}2\cdot\tau^2-$ $-1497{,}8\cdot\tau+13945$	$80{,}4\cdot\tau - 1497{,}8$
	3		$-3{,}351\cdot(\tau-19{,}25$	$-10{,}053\cdot(\tau-19{,}2$	$-10{,}1\cdot(2\tau - 38{,}5)$

On the basis of Table 4, are represented the time variation of generalized coordinates, velocities and accelerations.

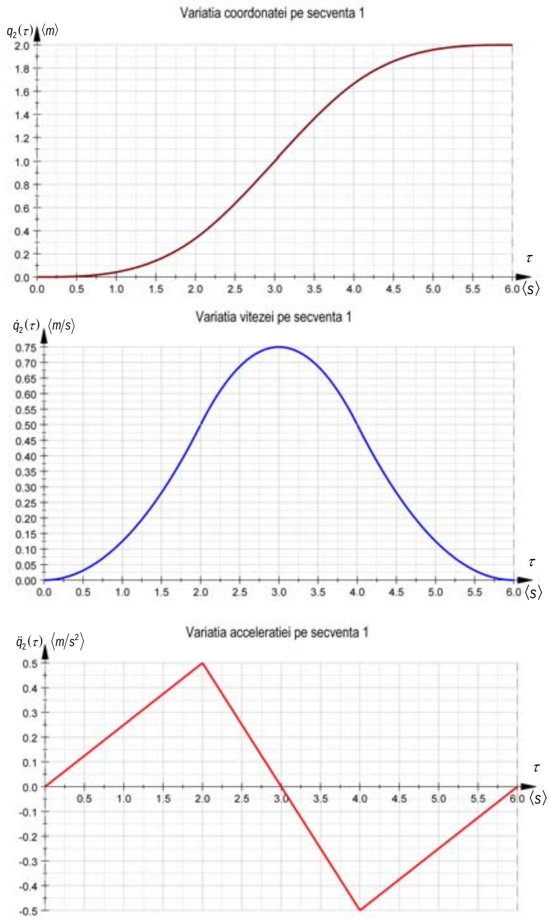

Fig. 4 The kinematical parameters on sequence $j = 1$

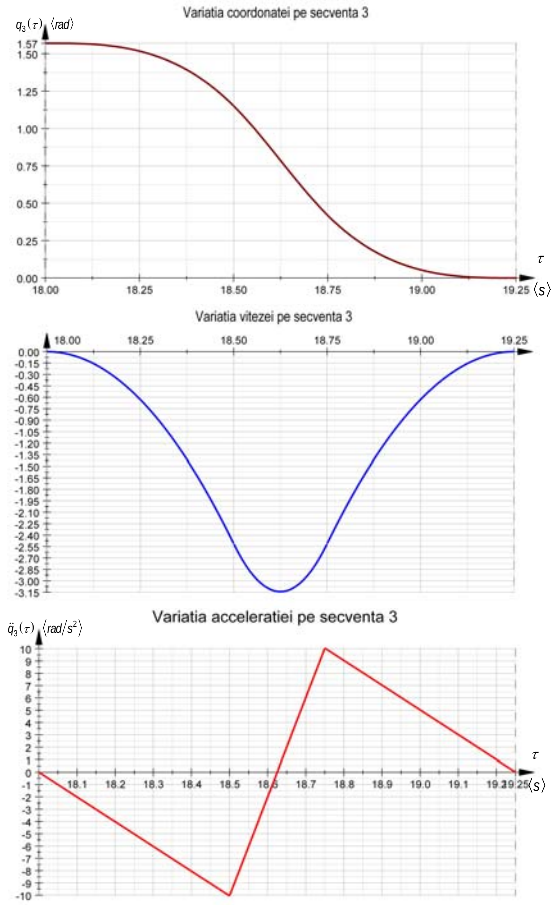

Fig. 5 The kinematical parameters on sequence $j = 3$

On the basis of expression (6) and (9), are represented graphically the variation for the driving moments, on the sequences $(j = 1, 3)$.

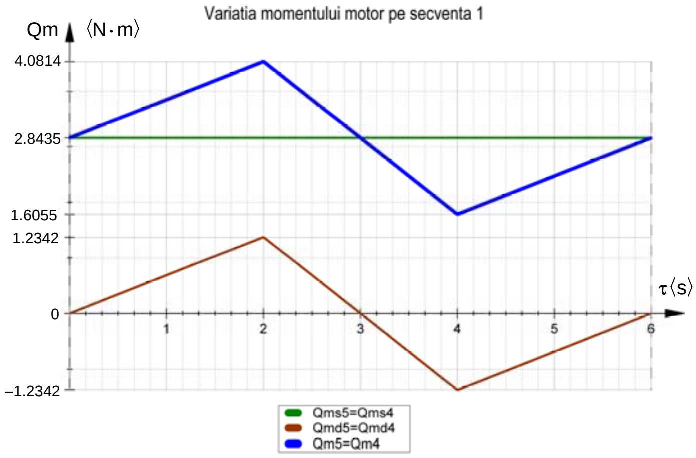

Fig. 6 The variation of driving moments (sequence $j = 1$)

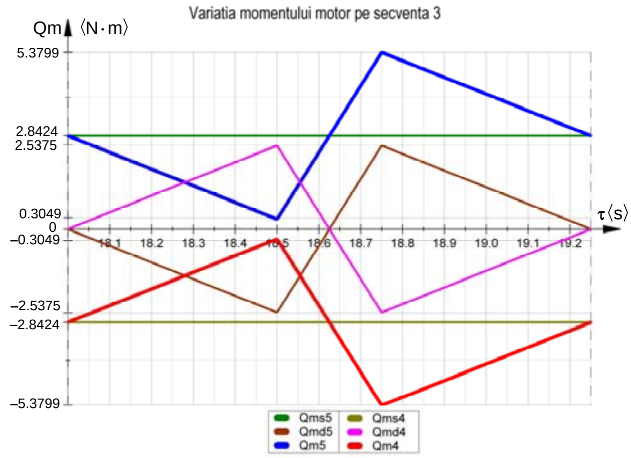

Fig. 7 The variation of driving moments (sequence $j = 3$)

The previous graphics are representing the variation with respect to time of the driving moments, in the case of the two independent movements: linear translation and rotation for orientation. Their determination was based on the conditions necessary to achieve a straight shift or orientation of the robot and the kinematic constraints.

5. CONCLUSIONS

In the above presented paper there have been developed the dynamic control functions for the mobile robot PatrolBot. Using as starting point the dynamics equations, in keeping with the conditions which must be taken into account for straight line displacement or orientation, there have been deduced the driving moments of the wheels. The dynamic model of the structure is based on acceleration energy, which substituted in the specific expression of mechanical systems with nonholonomous links are leading to differential equations of motion for the mobile robot PatrolBot. Having the driving moments of the wheels, the structure was integrated in a technological process. The process has been modeled using (3n).type with restrictions polynomial functions, in keeping with the conditions necessary to achieve a straight shift or orientation of the robot and the kinematic constraints. For two sequences of the working process, consisting in a linear translation and a rotation for orientation, there were represented graphically the variation in time of the driving moments. As a final conclusion, the graphical representation is in accordance with the real working process of the mobile robot PatrolBot.

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Contribuții cu privire la dinamica robotului mobil de tip PatrolBot

Rezumat: În conformitate cu faptul că roboții în timpul operațiunilor efectuează traiectorii de mişcare situate în spațiul configurațiilor, sau în spațiul cartezian, se impune un control permanent al parametrilor cinematici, respectiv al forțelor generalizate din fiecare cuplă motoare, în scopul obținerii unui control precis al parametrilor dinamici. Aşadar, scopul lucrării este determinarea ecuațiilor dinamicii pentru o structura mobilă de tip PatrolBot. Ecuațiile de mişcare vor fi determinate pe baza unor noi concepte în mecanica avansată cum ar principiile variaționale, cu privire la energia accelerațiilor, care reprezintă o parte importantă din cercetările ştiințifice desfăşurate de către autorul principal.

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