International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

IJIEMR Transactions, online available on 30th Jun 2021.
Link: https://www.ijiemr.org/downloads/Volume-10/ISSUE-6

DOI: 10.48047/IJIEMR/V10/I06/36

Title: **MODEL OF DISTRIBUTION OF ENERGY RESOURCES DURING THE MOTION OF INDUSTRIAL ROBOTS**

Volume 10, Issue 06, Pages: 176- 178

Paper Authors: **H.I Khonboboyev**

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

MODEL OF DISTRIBUTION OF ENERGY RESOURCES DURING THE MOTION OF INDUSTRIAL ROBOTS

H.I Khonboboyev
Associate Professor of Kokand State Pedagogical Institute, Candidate of Technical Sciences

Abstract: The article examines the control model of an industrial robot moving in changing conditions. It takes into account dynamic coefficients in the expression of the equation of motion of an industrial robot, a damper, a dynamic coefficient representing the force of gravity on the links when moving a load from one point to another, strength coefficients that determine the force of the link.

Keywords: industrial robot, dynamic coefficients, parametric deviations, robot load level, strength factor.

Introduction

Traditional robot control methods are a complete and accurate dynamic model of the mechanism and its movement, based on known and specific conditions. In almost all cases the appearance of the structure of the equation of motion of the robot and even the values of the unknowns included in the equations are also known. The control algorithm implementing such a system.

When deviations occur that do not support qualities under different influences, management is required about. As a result, the accuracy of the movement of the robot decreases, stagnation disappears and transition oscillations increase [1,2].

How the robot control system changes under the influence of deviations to the synthesis of optimal control algorithms, the movement of the robot before moving on to the initial, unknown and parametric control quality? The answer to this question is that if the degree of loading of the robot increases, then the difference between the specified trajectory and the real trajectory increases under the influence of parametric deviations, which leads to an increase in the probability of the robot hitting a technological obstacle or, in some cases, an emergency mode. This makes it necessary to conduct research work on the control model of an industrial robot (SR) moving in changing conditions.

In general, the equation of motion of the SR working arm moving under variable conditions that given by [1]:

$$A(q,\xi)\ddot{q} + b(q,\dot{q},\xi) = u, \quad (1)$$

where q is the n-dimensional generalized coordinate vector;

$\dot{q}, \ddot{q}$ – q is the 1st and 2nd order product of the vector in time;

u – control vector for n-dimensional moments;

ξ – SR working arm and vector of load parameters moving from one point to another (link length, link weight and torque inertia, load weight, etc.);

$A(q,\xi)$ – SR status determinant (nxn) - dimensional matrix function;

$b(q,\dot{q},\xi)$ – SR is an n-dimensional vector function representing the moments of the working arm links.

Let's imagine, $q_{das}(t)$ is a given program trajectory.

The challenge is to manage the moments of given trajectory with a given accuracy in the synthesis of the algorithm to move around. In parallel optimization of energy resources in torque management and issues such as the proper

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

distribution of energy resources across the links also arises. Under clear initial conditions and unknown parametric deviations, solving such problems is difficult [3].

The initial deviation is equivalent to the exact initial condition

that follows:

$$z(t_0) = \begin{pmatrix} q(t_0) - q_{das}(t_0) \\ \dot{q}(t_0) - \dot{q}_{das}(t_0) \end{pmatrix}$$

The parametric deviation $|\xi - \bar{\xi}|$ is measured in $\bar{\xi} - (1)$ magnitude, where is ξ the estimate of the parameter in equation (1).

If $z(t_0) = 0$ then, $\xi = \bar{\xi}$, . The SR control system goes into a deterministic state. Accordingly, Equation (1) looks like this:

$$u_{das}(t) = A(q_{das})\ddot{q}_{das} + b(q_{das}, \dot{q}_{das}) \quad (2)$$

For variable conditions, Equation (2) is rare in practice.

Dynamic coefficients in the expression of the equation of motion of SR,

damper, which falls on the links as the load moves from one point to another

dynamic coefficient of gravity, the combination of links the virginity coefficients that determine the strength are taken into account. Given in the equation taking into account the given coefficients, and this conditions for the coefficients are derived [1].

Equation (1) is in Cartesian coordinate system and canonical

be given as follows:

$$\ddot{x}(t,\xi) + f\big(x(t,\xi), \dot{x}(t,\xi)\big)\dot{x}(t,\xi) + c\big(x(t,\xi)\big) = u(t,\xi) \quad (3)$$

there $f(\bullet)$ – n – has a first-order continuous product in dimensional space;

$c(\bullet)$ - n - continuous in dimensional space;

$$|u(\bullet)| \le M < \infty.$$

By reducing the order of equation (3), the following system of equations is formed:

$$\begin{cases} \dot{x} = y, \\ \dot{y} = -f(x,y) - c(x) + u \end{cases} \quad (4)$$

Because the system has a variable coefficient and a complex appearance, it is important to determine if there is a solution. To do this, include a function that represents the power supply of the SR worker:

$$V(x,y) = \frac{y^2}{2} + \int_0^x c(s)ds \quad (5)$$

(5) The expression for the links is as follows:

$$V_i(x,y) = \frac{y_i^2}{2} + \int_0^x c_i(s)ds, \quad i = 1,2,\ldots,n. \quad (6)$$

Consumption of energy resources for SR is one of the main tasks use one.

$$\frac{dV}{dt} \le M|y| \le M\left(\frac{y^2}{2} + 1\right)$$

$$\frac{dV}{dt}[V(t) + 1] \le M[V(t) + 1]$$

From the last inequality we can write:

$$V(t) + 1 \le [V(0) + 1]e^{Mt} \Longrightarrow$$

$$V(t) \le [V(0) + 1]e^{Mt} \quad (7)$$

if equality (5) is used,

$$y^2 \le 2[V(0) + 1]e^{Mt}.$$

(4) The solution of the system of equations is as follows:

$$x(t) = x_0 + \int_0^t y(s)ds.$$

If the last inequality is used,

$$x(t) \le x_0 + Ce^{M\tau}, \qquad 0 \le t \le \tau.$$

(7) from inequality *V(t)* the function is limited and hence (4) the system solution time is $0 \le t \le \infty$ in the interval.

Speed problem for SR moving in changing conditions. Considering the impossibility of putting the above energy resources consumption it remains to solve the problem of savings and proper distribution [1].

If you work on robots that work in changing conditions trajectory is represented in the form of graphs corresponding to the movement of

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

each link energy savings, given the need to increase and a conditional extreme to solve the problem of their proper distribution issue is used. (5) is the product of time:

$$\frac{dV_i}{dt} = y_i\dot{y}_i + c_i(x)\dot{x}_i = -f_i(x_i, y_i)y_i^2 + y_i u_i \quad (8)$$

Equation (8) is equal to zero and $V_i(x, y)$ the points of the function are determined:

$$\frac{dV_i}{dt} = y_i\dot{y}_i + c_i(x)\dot{x}_i = -f_i(x_i, y_i)y_i^2 + y_i u_i = 0,$$

$$y_i(-f_i(x_i, y_i)y_i + u_i) = 0.$$

$y \neq 0$ the second product $-f_i(x_i, y_i)y_i + u_i = 0$ will remain.

And these $y_i = \frac{u_i}{f_i(x_i, y_i)}$ will find the decision.

Solution (7) is passed to the function and the necessary solutions for the intermediate links are selected [4].

Optional $V_0 \geq 0$ Let's look at the curve in the spatial plane for:

$$V(x, y) = \frac{y^2}{2} + G(x) = V_0,$$

there $G(x) = \int_0^x c(s)ds$.

If $V_0 \geq 0$ it turns out that the curve has two branches, and they are:

$$y = yo\sqrt{2(V_0 - G(x))}.$$

At the beginning of $V_0 = G(x)$ will be.

Conclusion

Solutions found by conditional extremum are discrete provides the lowest and highest consumption of energy resources in the links. If the SR is subject to touch control, then its links to optimize energy consumption in continuous motion (3) The following qualitative criteria are applied to the equation:

$$C(u) = x'(T)Gx(T) + \int_0^T \left[\|x(t)\|_W^2 + \|u(t)\|_U^2\right] dt.$$

(3) The equation is the maximum of Pontryagin under the quality criterion solved on the principles of this equation.

References

1. Siddikov R.O. An industrial robot in a changing environment. The problem of optimization in the movement // «Informatics and energy Problems of Uzbekistan "magazine. –Tashkent, 2009. №6. 18-22-b.
2. Xonbabaev X.I. Industrial robot as part of technological modules mathematical model of the formation of the optimal trajectory and development of algorithms // Kand. disser. avtoref. Specialty 05.13.12. Tashkent, 2006. 20 p.
3. Chernorutskiy I.G. Methods of optimization // Uchebnoe posobie. St. Petersburg State Polytechnic University. –SanktPeterburg, 2012.152 p.
4. Siddikov R.O ‘., Aroev D.D. Mathematical model of control of an industrial robot with variable parameters // "Journal of Informatics and Energy" Uzbekistan. –Tashkent, 2010. №6. 26-29-b.