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The kinematics of final point of the holder robot manipulators

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Abstract

In this paper we investigate velocity and acceleration of the center of claw arm which consists of three links. The analytical formulas are obtained. These formulas can be used in engineering calculations of trajectories of robots.

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*Keywords:*Robot; claw arm; velocity; acceleration; transportation motion.

1. Introduction

Robotics is very frequently used in different industries for performing different technological processes. Application of smart robots in oil mining field is very important area of research. From this point of view, investigations of kinematics of robots and manipulators are a challenging problem. In this paper we investigate kinematics of center of claw arms. In the existing works, deterministic models for description of motional manipulators are used which is related to strong axiomatic assumptions. In real situation, investigation of motion of multidimensional manipulators is related to uncertainty, mainly to fuzzy uncertainty.

2. Preliminaries

Definition 1.Sum of fuzzy numbers
Let A and B be fuzzy numbers. The sum of fuzzy numbers A+B is defined as follows.

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$$\mu_{(A+B)}(z) = \sup_{z=x+y} \min\left[\mu_A(x), \mu_B(y)\right]$$

Definition 2.
The square of fuzzy number *A* denoted by μ_{A^2} is a continuous fuzzy number defined as

$$\mu_{A^2}(y) = \max\left(\mu_A\left(\sqrt{y}\right), \mu_A\left(-\sqrt{y}\right)\right)$$

Definition 3.
The square root of fuzzy number *A* denoted by $\mu_{\sqrt{A}}$, is a continuous fuzzy number defined as

$$\mu_{\sqrt{A}}(y) = \mu_A\left(y^2\right)$$

3.Robot manipulator consists of elements AB, BC and CK. AB element has vertical axis, angle of rotation is ϕ BC and CK rotate in vertical plane with angles of rotation θ_1 and θ_2. The velocity of the holder and acceleration are the final point which requires to define W_k to denote this velocity as $\bar{V}$ and acceleration as $\bar{W}$.

4. Determination of velocity

Rotation radius of point C around vertical axis is denoted as EC.

$$EC = l_1 \sin\theta_1$$

The length of elements BC and CK is denoted as l_1 and l_2. The rotation radius of holder K around vertical axis is OE.

$OE = OC + CE = l_2 \sin\left(\theta_1 + \theta_2\right) + l_1 \sin\theta_1$.

The holder executes the compound motion.
Its velocity consists of geometrical sum of 2 velocities

$$\bar{V} = \bar{V}_r + \bar{V}_c \qquad (1)$$

Here is a relative velocity $\bar{V}_r$ located on drawing plane. The velocity $\bar{V}_r$ is equal to geometrical sum of $\bar{V}_{r_1}$ and $\bar{V}_{r_2}$.

$$\bar{V}_r = \bar{V}_{r_1} + \bar{V}_{r_2} \qquad (2)$$

Velocity $\bar{V}_{r_1}$ directed on the point C perpendicularly to BC to rotation θ_1

$$V_{r_1} = \dot{\theta}_1 l_1 \qquad (3)$$

$\bar{V}_{r_2}$ directed on point CK perpendicularly to Ck to rotation θ_2