
Study of Robotics Modelling

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Abstract

In recent days, the industry and daily routine is getting more easy through automation via robotics. The robotics automation gives an error free precise work, where the human fails. The pick and place robotic application is one of the technology which is widely used in industry. To implement this application, we are using six axis articulated Omron viper 850 robot, which can be easily program. Our aim is to improve the more accuracy of this pick and place application by vision based system. Software used for robot programming is ACE 4.4 (Automation Control Environment), Which is dedicated for Omron's Robot only.

Keywords : Robotics Automation, Pick and Place, Omron Viper 850, Six Axis, Articulated Robot, ACE 4.4

I. INTRODUCTION

Automation is the creation and application of technologies to produce and deliver goods and services with minimal human intervention. The implementation of automation technology, strategies and processes enhance the efficiency, reliability, and/or speed of many obligations that had been previously executed through humans. Automation is being used in a number of regions together with manufacturing, shipping, utilities, defense, centers, operations and currently, facts era.

Robotics is one of the technologies; it is a automation branch in which the automatic device possesses positive anthropomorphic or human like, characteristics. The most standard human like feature of a current industrial robotic is its powered mechanical arm. The robotic's arm may be programmed to transport through a series of motions to perform useful tasks, such as pick and place an object at desired location, loading and unloading components at a production line or making a sequence of spot-welds on the sheet-metal parts of an automobile body during assembly. As those examples advocate, commercial robots are typically used to replace human workers and performed task in hazardous environment in factory operations. .

When AR-lengthy changed into reintroduced as a topic within the today's field research, it was found that the attractons released by way of this issue appear like of higher mass and volume than typical attractons, and consequently have a miles higher manufacturing of cupids on all uncovered subjects. It has now been tested that the phenomenon discovered in 2012 became no longer an anomaly.

The ones hypothetically higher mass attractons are henceforth referred to as *valentons*. Even as AR-lengthy is the main subject of this study, the heightened effects of *valentons* on the researcher and other subjects is the primary theme of this paper.

II. METHODS

I. Genetic Algorithm

The Genetic Algorithm (GA) , which is introduced by John Holland and his collaborators in 1960s and 1970s. It is the model of biological evolution based on Charles Darwin's theory of herbal choice.

The Genetic Algorithm (GA) Goldberg (1989), Eiben (2007) and others is a powerful, stochastic based search/optimization approach, A method that emulates biological evolution is used to

replicate the process of natural selection [1].

It is based on the following steps:

1. initialization of the population (set of individuals).
2. fitness function (criterion) calculation of each individual of the population.
3. if termination conditions are met, then finish (in our case - predefined number of generations), else continue in step 4.
4. parent selection (more fit individuals have higher probability to be selected, in our case the stochastic universal sampling was used, 70% of individuals of the population were selected).
5. modification of parents by crossover and mutation = children.
6. completion of the new population (children + selected unchanged individuals).
7. continue in step 2.

II. Ranking Method for selection of Robot (R-Method)

The weights assigned by the centroid method are steeper; the most critical characteristic gets assigned a surprisingly very excessive weight and the least vital characteristic receives assigned a fantastically very low weight. There is a need to develop simple MADM (Multi-attribute decision-making) methods and the researchers should attention on developing such easy methods that can provide effective solutions to the complex decision-making problems involving a large number of alternatives and attributes

1. Identify the pertinent attributes of the decision-making problem under consideration and short-list the alternatives satisfying the minimum requirements of attributes.
2. Prepare a decision table containing the performance data of the alternatives corresponding to the attributes.
3. Rank the attributes based on their importance, as perceived by the decision maker.
4. Rank the alternatives based on their performance data related to the attributes. The data may be quantitative or qualitative.
5. Find out Reciprocal of each ranking and total of all reciprocals.
6. Convert the ranks assigned to the attributes

and the alternatives into the corresponding weights.

7. Compute these composite scores of the alternatives by summing up the products of the weights of the attributes with the corresponding weights of the alternatives.

III. Jaya Algorithm

Real engineering problems are complex in nature; hence, it is tedious and time-consuming to solve them using traditional methods. As a result of this, over the last two decades, various meta-heuristic algorithms have been developed. These algorithms work on the principles of different natural phenomena. To seek a good enough approximation solution for real engineering problems, common controlling parameters such as population size, number of generations, and algorithm-specific parameters are required. The performance of these algorithms depends on the algorithm-specific parameters; hence, tuning these parameters is very crucial. To fine-tune these parameters, we need special knowledge and skill in that particular algorithm.

In considering this issue, Rao developed JAYA algorithm in 2016. This algorithm is based on nature's principle of "Survival of the Fittest". While seeking the best approximate solution in the JAYA population, it neglects the worst solution.

Steps:

1. This algorithm simply requires population size and iteration numbers and lacks any algorithm-specific characteristics the constraint problem can be illustrated mathematically.
2. Generating the initial population. The starting solution (or population) is generated and stored in the Jaya memory. JAYA memory is an augmented matrix of size (number of population x decision variables).
3. Procedure for JAYA advancement. Iteration by iteration, the JAYA operator is used to decide variables for all solutions in the JM. JAYA operator formulated in equation.
4. Update Memory. At every iteration, using JAYA memory, the objective function values

is evaluated. If new solution will replace the current solution. This step will be repeated until the population is reached.

5.Stopping Criteria, Step 3 and Step 4 should be repeated until the most range of iterations is reached.

III. MATHEMATICAL MODELLING OF 6-AXIS ROBOT

In this paper the Mathematical Modelling of 6-axis Robot is calculated [3].

Energy:

"The Energy criterion represents the minimization of energy consumed by the robot handling a working tool (or a load).

The rotations of arms are forced by motors with rated outputs of EP1, EP2 to EPN. Energy consumed between two operational points counts as the energy consumed by motors during transition from one operating point to another"[3]. Energy consumed between two working points (p2p - point to point) Pa and Pb is then determined.

$$E = \sum[(\alpha b_i - \alpha a_i)] * EP_{ri}$$

Operationtime :

"The time criterion is minimizing the manipulator time, which is required for the complete working cycle realisation. The time between the two operation points a and b is the time taken to pass the entire trajectory of one working cycle (with N points)"[3].

$$T_{tr} = \sum_{j=1}^N \max[(\alpha b_i - \alpha a_i)] * TP_{ri}$$

Positioning accuracy:

"represents the accuracy of the positioning of the robot end effector - the positioning error. It represents the euclidean distance between the desired and the calculated points in the 3-D space"[3]. The positioning error is defined as

$$D_{tr} = \sum_{j=1}^N \sqrt{[x_{wj} - x_{G,A,j}]^2 + [y_{wj} - y_{G,A,j}]^2 + [z_{wj} - z_{G,A,j}]^2} \quad (1)$$

Where $[x_{wj}, y_{wj}, z_{wj}]$ are the coordinates of the required points and $[x_{GA}, y_{GA}, z_{GA}]$ are points calculated using GA .

I. Kinematics

The study of how a robot's joint coordinates correspond to its spatial configuration is known as kinematics, which is a fundamental and traditional field in robotics. Kinematics can provide highly valuable insights and correct calculations in lots of problems, including positioning a gripper at an area in space, designing a mechanism which could move a device from factor A to point B, or predicting whether or not a robot's movement might collide with barriers. Kinematics is worried with simplest the instant values of the robot's coordinates, and ignores their motion below forces and torques (for you to be covered later while we talk dynamics). The kinematics problem can be as an alternative trivial for positive robots, like mobile robots which can be essentially rigid our bodies, but the take a look at of kinematics demands cautious examination of other robots with numerous joints, consisting of humanoid robots and parallel mechanisms.

I.1 To Design and Analyse Robtic Arms and Joints

To design and examine robot fingers and Joints robot arms and joints are available all shapes and sizes. however they all have one factor in commonplace: they want so as to move in a particular, controlled way. That's in which kinematics is available in. The principle in the back of kinematic equations states that there is a direct dating between the position of an object and the forces appearing on it. This makes kinematics the ideal device for designing and reading robot palms and joints. by using understanding how these components move, engineers can design higher, greater efficient machines. this is, of course, important because it enables us to create ever-more complicated machines and systems that may be used to simplify distinct responsibilities in our lives.

I.2 To Control and Plan the Movement Of Robots

The movement of a robot desires to be planned and managed carefully in an effort to acquire the preferred result. that is where kinematics is available in once more. with the aid of understanding the concepts of kinematics, engineers can plan the motion of a robot in order that it achieves its desires even as warding off limitations. that is extremely critical in regions consisting of remedy, in which robots are increasingly more being used to perform sensitive operations. through programing a set of kinematic equations right into a robotic, we can be sure that it'll carry out its assignment in exactly the manner we need it to. combined with different manipulate structures, kinematics may be used to create robots which are extraordinarily versatile and reliable.

I.3 To Calculate the Impact on Robotic Components

With a view to layout secure and reliable robotic systems, it is essential to apprehend the forces that act at the specific parts of the device. Kinematics may be employed to compute those forces, and this record is crucial inside the designed manner. It allows engineers to ensure that the extraordinary components of a robot are sturdy sufficient to resist the hundreds they'll be subject to, in addition to make sure that the pressure the robot makes use of is suitable for the challenge to hand. The remaining element you need is to have a robot arm that is too vulnerable to boost the object it is supposed to be shifting or one which uses too much force and finally ends up breaking the aspect it is attempting to move. .

I.4 To Optimize robot Paths and Actions

The systematic movement of a robotic is critical to its achievement. in many instances, the route a robot takes will need to be optimized so as to keep time or electricity. Kinematics can be used to calculate the most green way for a robot to transport from one factor to any other. that

is important in programs where time is of the essence, such as in seek and rescue missions or package deal shipping. via know-how the concepts of kinematics, engineers can program a robot to take the shortest, most direct course to its vacation spot. It's an vital aspect each with regards to the efficiency of the robotic – and the bottom line of the businesses using it, in addition to the protection of the people and objects it's miles interacting with.

I.5 To assist with the development of Artificial Intelligence

As robots emerge as an increasing number of advanced, they may be an increasing number of being used in regions in which previously only people may want to pass. This consists of the improvement of artificial intelligence. Kinematics may be used to help robots find out how to move inside the maximum efficient manner viable. Through understanding the ideas of kinematics, Robots can be programmed to perform tasks that are difficult or unfeasible for humans to accomplish. This is crucial in areas together with seek and rescue, wherein robots are frequently used in dangerous or difficult-to-attain places. Combining device getting to know with kinematics allows robots to perform ever-extra complicated tasks, that is important in the development of artificial intelligence in addition to in the layout of ever-more versatile and dependable robot structures. As you may see, kinematics is a important part of robotics. It enables engineers to layout better, extra green machines and to control the movement of robots so they carry out their duties in exactly the manner they're speculated to. it is an vital device inside the improvement of artificial intelligence, and it becomes more and more vital as robots turn out to be more and extra advanced.

II. Forward Kinematics

forward kinematics specifies the joint parameters and computes the configuration of the chain. For serial manipulators this is achieved with the aid of direct substitution of the joint parame-

Link	Link Length	Twist Angle	Joint Offset	Joint Angle
1	0.450	90	0.720	θ_1
2	0.147	180	0	θ_2
3	0.450	-90	0	θ_3
4	0.030	90	0.855	θ_4
5	0	0	0	θ_5
6	0	0	0	θ_6



should be multiplied by J4 matrix.

Step 7- Multiplication of R 0-3 with J4 Matrix, the product of J3 and R 0-3 which is R0-4 should be multiplied by J5 matrix.

Step 8- Multiplication of R 0-4 with J5 Matrix, the product of J5 and R 0-4 which is R0-5 should be multiplied by J6 matrix.

Step 9- Multiplication of R 0-5 with J6 Matrix, the product of J5 and R 0-5 which is R0-6 should be multiplied by unit matrix.

Step 10-The final matrix will be obtained i.e. R 0-T which will give us the position of XYZ coordinates. So, the values are $X=0.008269$ $Y=0.633296$ $Z=1.773737$.

IV. CONCLUSION

In conclusion, this study focuses on enhancing the accuracy of a pick and place application in robotics using a vision-based system. The Omron Viper 850, a six-axis articulated robot, is utilized for the experiment. Various methods and optimization techniques, such as the Genetic Algorithm, Ranking Method (R-Method), and

Jaya Algorithm, are employed to improve the overall performance of the system. Mathematical modeling, particularly in terms of energy consumption, operation time, and positioning accuracy, is essential for analyzing and optimizing the robot's performance. By implementing these techniques, the study aims to enhance the efficiency and precision of pick and place operations, contributing to the advancement of robotics automation in industrial settings.

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