

Trajectory Planning for Robot Manipulators Using Intelligence Techniques

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ABSTRACT: The formulation and application of trajectory planning for manipulator using intelligence techniques in 3 armed planar, target position, minimum cost in manipulator orientation. The path is being generated and given as input to the robot, manipulator and tip moves along that specific path. The advantage of optimize performance in path control and accuracy. The objective function minimize cost function with constrains being joint position, velocity, jerk and torque by considering dynamic equation of motion .The main target is the generation of trajectory from start to goal that satisfies objectives such as minimizing, path travelling distance (or) time interval, lower energy consumption (or) obstacle avoidance and satisfy the robot's kinematics and dynamics.

KEYWORDS: Path control, Constrains, Kinematics and dynamics, Algorithm

I. INTRODUCTION

To develop an artificial intelligent 3 armed planar manipulator. During the past decades many researchers have tries to sort out the problem of motion planning and control. The main objectives function deals with obstacle avoidance and optimization problem is synthesized using penetration distance between collisions. The algorithm based search and intelligence techniques are machine learning, robot motion planning, scheduling, pattern recognition, image sensing. The application of algorithm to find the optimal trajectory of manipulators also highlighted. This type of trajectory planning can produce very high execution velocities, particularly when transfer time is minimized.

The resulting motion physically feasible is minimized under position, velocity, acceleration, jerk, torque characteristics. Traditional techniques such as SQS cannot solve discontinuous terms (Ex: frictions).

1.1 DIFFERENTIAL EVOLUTION; (DE)

Differential evolution is an improved version of genetic algorithm for faster optimization. Genetic algorithm that uses binary coding for representing problem parameters, differential equation uses real coding of floating point number. The simple adaptive scheme used by DE ensure that the mutation increments are automatically scaled to the correct magnitude. The overall structure of the DE algorithm resembles that of most over population based searches.

1.2 GENETIC ALGORITHM

Genetic algorithm are search procedure being based on the mechanism of natural genetics, natural selection and minimum seeking algorithm. The generation by generation evolution of population of potential solution result in a convergence towards the best possible solution. GA borrowed the idea from the nature "survival of the fittest" with apopulation competing potential solution. The strategy that mimics the theory of evolution of life in nature belonging to the class of stochastic search method. Discuss brief on minimum seeking algorithm in optimization characteristic.

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1.3 MINIMUM SEEKING ALGORITHM

Optimization can be defined as the process of adjusting the input to the characteristic of a device, mathematical process, maximum output result. The cost is something to be minimized, optimization becomes minimization. In this method we can explain two types of approaches by using seeking algorithm: kinematic approach and dynamic approach are explained given below.

1.3.1 KINEMATICS APPROACH:

The objective is to find the sequence of time intervals that minimized the total time spent on moving between two points in space. The main feature of the approach is the dynamics of the arm is not considered at all, so that constraints consist of a set of bounds on position, acceleration, velocity. A new design method was proposed to set up the weight coefficient from which the characteristic of the optimized trajectory can be determined. Their approach was verified both theoretically and experimentally through SCARA robot. Minimum time point to point motion planning of robot manipulator was investigated considering kinematical constraints on speed and acceleration. A suitable objective function to combine the minimization of travelling time with smoothness of robot trajectory is selected. The effect of weights in the objective function and control knots on smoothness, time optimally and path deviation error are chosen mainly by simulation with a SCARA robot.

1.3.2. SCARA-ROBOT:

A SCARA robot means Selective Compliance Assembly Robot arm or Selective Compliance Articulated Robot arm. Its arm is rigid in the Z axis and pliable in the XY axis, which allowed it to adapt to holes in the XY axis. The advantage for many types of assembly operation is inserting a round pin in a round hole without binding. The SCARA robot provides more flexibility than the Cartesian robot. Its circular work envelope is created by 4 axis motions. SCARA robot can move with more flexibility in a horizontal plane. SCARA robots can be safeguarded from hazardous environments. All their joints can be protected and they can be sealed for underwater application.

1.3.3 DYNAMIC APPROACH:

The solution incorporates the full dynamic of movement and involves the joint space tessellated by dynamic time scaling algorithm and graph search. Perturbation trajectory improved algorithm (PTIA) which can generate the joint position velocity, torque under very general constraints are introduced. The trajectory planning can become complicated due to inter joint nonlinearities and the couple's characteristics of robot manipulator. A class of industrial robot with large reduction (gear) ratios, the coupled nonlinear dynamics is not significant.

The inverse dynamic refers to either inverse rigid body dynamic or structural dynamics. Inverse rigid body dynamics of computing force and moment based on kinematic of a body and the body's inertial properties. The application of inverse dynamics is robotics and biomechanics.

II. MOTION PLANNING

Motion planning for robot manipulators has been extensively studied during last decades. Depending on the nature of the problem some planning problem is divided into two categories;

1. Global motion
2. Local motion

Heuristic algorithms are fast but not guaranteed to find a solution even if there is one; their attractiveness resides in the fact that they will either find a solution (or) fail in a space of seconds. Local planner is commonly used in dynamic environment where limited information on moving obstacles is available.

Motion planning also known as navigation problem or the piano mover's problem is a term in robotics for the process of breaking into discrete motion that satisfies movement constraints and possibly optimizes some aspect of the movement. Motion planning has several robotics applications such as autonomy, automation and robot design CAD software, as well as application in digital characters, video game artificial intelligence, robotic surgery and study of biological molecules.

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III. OBSTACLE AVOIDANCE

Robot motion along such path would require the velocity of the tip to stop (or) slow down considerable at each corona. It need for some criterion other than minimum distance to be used for selection of the collision free path.

In robotics obstacle avoidance is the task of satisfying some control objective subject to non-intersection or non-collision position constraints. Obstacle avoidance is considered to be distinct from path planning in the reactive control law while the other involves the pre-computation of an obstacle-free path which a controller will then guide a robot along

IV. MULTI MOVER'S PROBLEM

The multi mover's problem is that of finding path for robots between their initial and final configuration while avoiding one another as well as any obstacles. The motion planning into system where multiple robots share the same environment, three approaches can be identified: centralized approach, the hierarchical approach and decoupled planning.

The centralized approach consists of treating the various robots were one single robot, consider the Cartesian product of their individual C-spaces called composite C-space. The forbidden region is the space in which one robot intersects an obstacle or two robots intersect each other. Algorithms based on this approach require a great amount of computational resources to store the resulting information of the representation of the composite C-space and for solving the path over this space.

The hierarchical approach plan the motion of robot according to a priority assigned to each robot depending on their specified task. In the decoupled planning path for each robot planned independently and are later synchronized by scheduling robot motion to ensure that no collision takes place while executing the desired task. The collision is studied using a bidimensional graph called collision map then the path of second robot is represented against time and collision region is identified.

V. CONSTRAINTS AND SOLUTION

Constraints represent the physical limitation imposed on robot kinematics and dynamic performance. Jerk constraints are introduced due to the fact that joint position tracking error increase when jerk increase, and also to limit excessive wear on the robot so that the robot life span is expanded. Minimum the cost function begin with: joint position, joint jerk, joint velocity and torque.

VI. CONCLUSION

Smooth motion was obtained by choosing adequate weight factor. Kinematic approaches gives interesting result but comes to reality inertia and torque. Dynamic approaches realistic incorporating torque constraints in terms of physical limit. In future work in testing and improving more complex robots task incorporating with real constraints.

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