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Optimal time, jerk and energy trajectory for a Cartesian parallel manipulator using multi-objective genetic algorithm

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Cartesian parallel manipulator (CPM) is a 3-Dof parallel manipulator that consists of a platform which is connected to the fixed base by limbs in three perpendicular planes. In this paper smooth singularity free trajectory planning optimization of the CPM is investigated. The forward and inverse kinematic equations of CPM are obtained by the robot geometrical constraints and its dynamic equations of motion are derived using Kane's method. Considering the actuators' limitation and kinematical constraints originated from the closed-chain nature of the CPM, an algorithm for trajectory definition and optimization for the robot end-effector is proposed using B-Spline functions without requiring any information about the geometry of CPM end-effector. The total required energy, maximum actuator's jerk and total time of motion are defined as three objective functions in terms of B-Spline parameters and non-dominated sorting genetic algorithm-II (NSGA-II) is used to solve the nonlinear constrained multi-objective optimization problem and calculate the optimal values of the trajectory parameters. Finally, the proposed algorithm is implemented in MATLAB software and its results are demonstrated and discussed which confirm the effectiveness of the presented method.

Biography

Mahmood Reza Azizi has completed his BS in Mechanical Engineering at Shahid Bahonar University of Kerman, Iran in 2006. He received his MSc degree in Mechanical Engineering from Bu Ali Sina University, Hamedan, Iran, in 2008 and is already PhD candidate of Mechanical Engineering in Tabriz University, Tabriz, Iran. His research interests include multi body system dynamics, robotics, nonholonomic systems, and nonlinear control.

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