A simple approach to solving the kinematics of the 4-UPS/PS *(3R1T)* parallel manipulator

Abstract

This work reports on the position, velocity and acceleration analyses of a four-degrees-of-freedom parallel manipulator, 4-DoF-PM for brevity, which generates Three-rotation-one-translation (3R1T) motion. Nearly closed-form solutions to solve the forward displacement analysis are easily obtained based on closure equations formulated upon linear combinations of the coordinates of three non-collinear points embedded in the moving platform. Then, the input-output equations of velocity and acceleration of the robot manipulator are systematically established by resorting to the theory of screws. To this end, the Klein form of the Lie algebra se(3) of the Euclidean group SE(3) is systematically applied to the velocity and reduced acceleration state in screw form of the moving platform cancelling the passive joint rates of the parallel manipulator. Numerical examples, which are confirmed by means of commercially available software, are provided to show the application of the method.