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MINIMUM TIME TRAJECTORY GENERATION FOR A NOVEL ROBOTIC MANIPULATOR

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Abstract. *A novel three degree-of-freedom (DOF) planar parallel robotic manipulator is proposed. The inverse displacement is briefly analyzed. Then three methods: quintic polynomial, linear segment with parabolic blends (LSPB), and s-curve are utilized to generate trajectories for point-to-point motion in joint space. Since rapidness for the robotic manipulator is a critical performance index, the minimum traveling time for all the methods are obtained satisfying the actuators' velocity, acceleration, and jerk limits. Moreover, the analytical expressions for them are derived. The minimum time for all the methods is compared, and s-curve is demonstrated to have the best performance compared with the other two methods. The analytical procedure developed in this paper for obtaining the minimum time can be readily applied to other serial or parallel manipulators.*
Keywords: Trajectory generation, Parallel manipulator, Quintic polynomial, LSPB, S-curve

1. **Introduction.** Compared with conventional serial manipulators, the parallel ones possess many merits such as high precision, large load to weight capacity, and high stiffness etc. Various applications of parallel manipulators can be found nowadays, such as airplane simulators, surgery machine, pick and place machine, machine tools, and even rehabilitation devices [1,2].

The planar parallel manipulators have attracted much attention due to their simple structure. A three DOF planar parallel manipulator is conventionally made up of three limbs connecting a fixed base to a moving platform. Merlet has enumerated all the seven feasible structures for them; however, all of them are based on the three limbs assumption [1]. In this paper, we propose a three DOF parallel manipulator with only two limbs. We have applied for China patent for this novel planar manipulator [3]. The solid model of proposed new manipulator is shown in Figure 1. It is composed of a double layer five bar part and a single four bar part lying between the five bar. Thus we call it five-four bar manipulator.

Compared with conventional three DOF planar parallel manipulator, the new manipulator is more compact in size. Moreover, due to the five-four bar architecture, the key advantage of the new manipulator is that when the five bar part is fixed, the moving platform can rotate about a stationary point for the characteristic of four bar mechanism. Potential applications of the manipulator include human gait generation and automatic Chinese cooking mechanism.