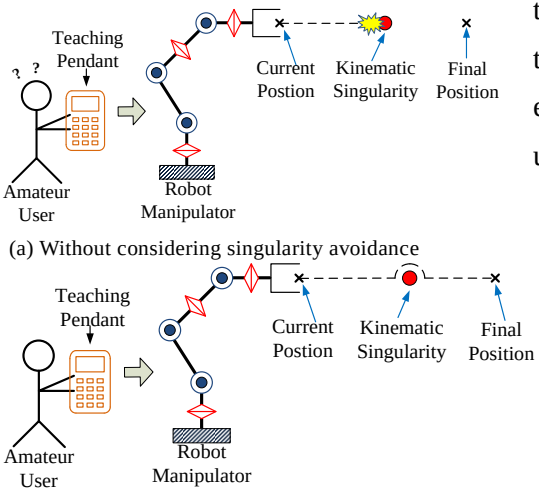
Teaching-Playback Robot Manipulator System in Consideration of Singularities

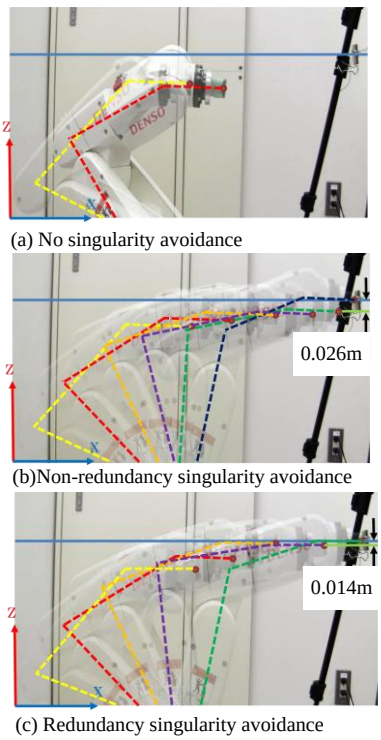
Normally, in the industrial robot teaching-playback system, a teaching pendant is used as a portable console in order to teach the robot, and there are many technicians who do not have expertise about robotics but still doing the teaching task to the industrial robot. For robot manipulator, a kind of singular posture in which the end-effector locality loses the ability to move in arbitrary direction. For those users who do not have the knowledge about that, it is difficult for them to consider the singular posture of robot; as a result, the end-effector will be difficult to be moved. Hence, the performance of the robot teaching system will be worse, and even cause some problems (as shown in Fig. 1(a)). The purpose of this study is to design a teaching-playback robot manipulator system that allows these non-expertise users to move the end-effector of robot manipulator from point-to-point by using teaching pendant without worrying about singular posture. In other words, when user move the end-effector come nearby the kinematic singularity, the end-effector will avoid the kinematic singularity automatically (as shown in Fig. 1(b)). The proposed methods of singularity avoidance will be taken account into non-redundancy and redundancy DOF robot manipulator system. Here, we compare the three systems obtained by adding a system that does not consider singularity avoidance. The trajectories of end-effector pass through the shoulder singularity (Fig.2. (a) system without considering singularity avoidance, (b) non-redundancy singularity avoidance system, (c) redundancy singularity avoidance system) and wrist singularity (Fig.3. (a), (b), (c) are same description as Fig.2) are verified in the experiment. The result shows that both of the proposed algorithms also can perform better than the system without considering singularity avoidance



(a) Without considering singularity avoidance

(b) With considering singularity avoidance

Fig. 1. Motion-teaching robot manipulator



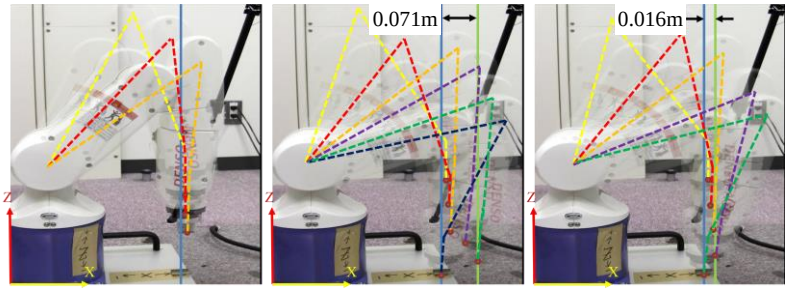
(a) No singularity avoidance

(b)Non-redundancy singularity avoidance

(c) Redundancy singularity avoidance

Fig. 2.Trajectory of end-effector moves from initial point to final point in shoulder singularity test using teaching pendant

Keywords: Robot manipulator, Singularities avoidance, Inverse kinematic, Jacobian Matrix



(a) No singularity avoidance (b)Non-redundancy singularity avoidance (c) Redundancy singularity avoidance

Fig. 3. Trajectory of end-effector moves from initial point to final point in wrist singularity test using teaching pendant