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FORCE/POSITION IMPEDANCE CONTROL FOR INSERTION AND PULL OF COMPONENTS IN SPACE MANIPULATOR STATION

Abstract

At present, most of the complicated and precise space operation tasks such as inserting and pulling pin, screwing and carrying of the space manipulator station depend on the astronauts. Especially, when carrying out the task of inserting and pulling pin, the operation space is limited and it is very inconvenient for the astronauts. In addition, there are some disadvantages of astronauts in performing the mission that need to leave the cabin, such as high cost, low efficiency, high risk. Therefore, it is of great significance to study the space manipulator to replace the astronauts to complete the task of inserting and pulling pin. Generally speaking, it has high precision requirements for the force, position and attitude control of the space manipulator to perform the task of inserting and pulling pin. If there is a large rigid collision during the process, the space manipulator is prone to failure. In order to solve above problems, considering the combination of force/position impedance control strategy, the dynamic relationship between force, position and attitude of the end of space manipulator can be regulated by the joint driving force, so that the end of the space manipulator can output the desired force and track the desired position and attitude. The proposed impedance control strategy is applied to the three bars space manipulator with uncontrolled base position and attitude for the process of inserting and pulling pin. At the same time, the process of inserting and pulling pin is divided into three stages: the preparation stage, closing impedance control strategy, making the end of the space manipulator reach the initial position; the adjustment stage, closing impedance control strategy, making the end of the space manipulator reach the top of the hole, adjusting the end attitude so that the pin is coaxial with the hole; the implementation stage, opening impedance control strategy, making the end of the space manipulator overcome the friction resistance along the desired trajectory to complete the space task of inserting and pulling pin. Through the numerical simulation experiment, the correctness and validity of the above control strategy and the process of inserting and pulling pin are verified. The simulation results show that, the end of the space manipulator can track the trajectory accurately and the force effectively. Combined with the subdivision idea of the process of inserting and pulling pin, the complex and precise on orbit task in space manipulator station is realized.