Homing Strategy for a 4RRR Parallel Kinematic Machine

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Abstract: Returning home is the most important process of a parallel kinematic machine (PKM) with incremental encoders. Currently, most corresponding articles focus on the accuracy of homing process, and there lacks the investigation of the operation's safety. For a 4RRR PKM, all servoaxes would be independently driven to their zero positions at the same time based on the traditional homing mode, and that can bring serious interfere of the kinematic chains. This paper systemically investigates this 4RRR PKM's safety of homing process. A homing strategy usually contains three parts which are the home switches' locations, the platform's initial moving space, and each links' homing direction, and all of them can influence the safety of homing operation. For the purpose of evaluating and describing the safety of the homing strategy, some important parameters are introduced as follows: Safely homing ratio (SHR) is used to evaluate the probability of a machine's successfully returning home from an initial moving space; Synchronal rotational angle (SRA) is the four links' largest synchronal rotational angle with given directions from a given pose. Whether a machine can safely return home from a given pose can be judged by comparing the SRA with all four home switches' mounting angles. By meshing the initial moving space and checking the safeties of returning home from all the initial poses on the nodes, the SHR of this initial moving space can be calculate. For the sake of convenience, the platform's initial moving space should be as large as possible, and in this 4RRR PKM, a square zone in the center of the workspace with a giving initial rotation range is selected as the platform's initial moving space. The forward direction is selected as each link's homing direction according to custom, and the platform's initial rotational angle is selected as larger than 0° based on this 4RRR PKM's kinematic characteristics. The platform's initial moving space can be defined only by the side length of the initial moving square. By setting a probable searching step and calculating the SHR of the initial moving square, an optimal procedure of searching for the largest side length of the platform's initial moving square is proposed. The homing strategy proposed is based on a systemic research on the safety of homing process for PKM, and the two new indexes SHR and SRA can clearly describe the safety of homing operation. The homing operation based on this strategy is fast and safe, and the method can also be used in other PKMs with the situation of serious components' interference.

Key words: homing strategy, safely homing operation, maximum safely homing space, redundant parallel kinematic machine