Optimum Seeking of Redundant Actuators for M-RCM 3-UPU Parallel Mechanism

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Abstract

This paper focuses on a 2R1T 3-UPU (U for universal joint and P for prismatic joint) parallel mechanism (PM) with two rotational and one translational (2R1T) degrees of freedom (DOFs) and the ability of multiple remote centers of motion (M-RCM). The singularity analysis based on the indexes of motion/force transmissibility and constraint shows that this PM has transmission singularity, constraint singularity, mixed singularity and limb singularity. To solve these singular

problems, the quantifiable redundancy transmission index (RTI) and the redundancy constraint index (RCI) are proposed for optimum seeking of redundant actuators for this PM. Then the appropriate redundant actuators are selected and the working scheme for redundant actuators near the corresponding singular configuration are given to help the PM go through the singularity.

Full Text

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Figures

Figure 1

The structure diagram of M-RCM 3-UPU PM

Figure 2

Inverse kinematics of M-RCM 3-UPU

Figure 3

UPU limb

Figure 5

The contour map of LTI

Figure 6

The transmission singularity

Figure 7

The contour map of TCI

Figure 8

The constraint singularity

Figure 9

The Limb singularity

Figure 10

Figure 11

Mixed singularity

Figure 12

RTI near the transmission singularity

Figure 13

RCI near the constraint singularity

Figure 14

RTI near the mixed singularity

Figure 15

RCI near the mixed singularity