

空间转动3-SPS-1-S型并联机构奇异位形研究 Singular Loci Analysis of 3-SPS-1-S Spatial Rotation Parallel Manipulator

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关键词: 并联机构 奇异位形 运动性能 可操纵度

摘要: 奇异性是机构的固有性质, 奇异位形分析对并联机构的轨迹规划和控制具有重要的意义。研究一种空间转动三自由度3-SPS-1-S型并联机构的奇异位形, 构建了该并联机构的运动学模型, 建立了机构位置逆解与速度映射解析方程, 并求出了机构Jacobian矩阵; 提出该机构奇异位形的判别准则, 并引入了可操纵度这一运动性能评价指标进行奇异性分析。分析结果表明, 该机构在指定任务空间具有良好的可操纵性与运动性能, 但在工作空间内具有发生位形奇异的可能, 在运动过程中应当避开特殊运动位置以避免奇异位形的发生。 Singularity is an inherent nature of mechanism, which make a significant impact on mechanism's work performance. The singularity loci of a spatial rotation 3-SPS-1-S parallel mechanism was studied. The parallel robot kinematics model was constructed. The equations for inverse displacement and velocity kinematics were derived, and the Jacobian matrix of this mechanism was analyzed. The singularity criterion was proposed, and two types of singularity were determined to be singular configuration. Manipulability degree was introduced to evaluate kinematical performance of the parallel manipulator for the singularity loci analysis. The results showed that the parallel mechanism has a good manageability and kinematics performance in the specified task space, but the special motion position should be turned away to avoid the occurrence of singularity.

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