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一种柔索并联机器人的可达工作空间分析与刚度评价

汤奥斐,仇原鹰,段宝岩

西安电子科技大学 机电工程学院，陕西 西安 710071

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摘要 大射电望远镜(LT)馈源柔索支撑系统可视为一种柔索并联机器人(WDPR)．基于馈源柔索支撑系统的非线性力学模型，引入张力、球铰和索长约束条件，确定了WDPR的可达工作空间．进而，借助于有限元分析方法，利用静刚度阵的最小奇异值来评价该机器人的刚度性能．通过对LT50m WDPR缩尺模型的空间运动数值仿真，绘制了三维可达工作空间图形及刚度曲面．分析结果表明，张力约束条件对LT可达工作空间影响最大，WDPR机器人与Stewart平台的刚度有明显差异．

关键词 大射电望远镜 柔索并联机器人 工作空间 刚度

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Analysis of reachable workspace of a wire driven parallel robot and its stiffness estimation

TANG Ao-fei,QIU Yuan-ying,DUAN Bao-yan

School of Mechano-electronic, Xidian Univ., Xi′an 710071， China

Abstract

The feed cable-supporting system of the large radio telescope (LT) can be regarded as a wire driven parallel robot (WDPR). Based on the nonlinear mechanics model of this system, the reachable workspace of the WDPR is confirmed to be subject to the restrictions on the cable tensions, spherical joints, and cable lengths. Furthermore, the static stiffness matrix of the WDPR is established by the finite element analysis to estimate the stiffness characteristics utilizing the minimum eigenvalue of the matrix. Through the kinematic numerical simulation, the stiffness curved surface and the three-dimensional reachable workspace of the 50 meter scaled model of the WDPR are drawn respectively. Results show that the restriction on the cable tensions has the most prominent effect on the reachable workspace, and that the differences of the stiffness characteristics are obvious between the WDPR and Stewart platform.

Key words large radio telescope wire driven parallel robot workspace；stiffness

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通讯作者