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微纳技术与精密机械

3-DOF并联机械腿动力学建模与伺服电机峰值预估

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摘要： 提出了一种结构紧凑、承载能力大、转动解耦性好、运动速度和加速度大的3自由度并联机械腿。为了对其进行驱动参数分析,对机械腿进行了动力学建模,并基于动力学模型进行了伺服电机峰值预估。首先,分析了腿部机构各构件的运动参数,采用Lagrange方程建立了动力学模型,得出了机构驱动力的显式解;接着,在机构动力学模型的基础上,建立了伺服电机驱动转速和驱动力矩的峰值预估模型;最后,通过给定一组结构参数和运动轨迹函数,得出了伺服电机驱动转速和驱动力矩随时间变化曲线,得到了机构的动力学特性,并验证了峰值预估模型的正确性。计算表明,3个伺服电机驱动转速的峰值分别为N_x=19 r/s、N_y=17 r/s、N_w=27 r/s;3个伺服电机驱动力矩的峰值分别为ε_x=5.8 N・m、ε_y=3.1 N・m、ε_w=4.4 N・m。

关键词： 并联机械腿 伺服电机 动力学分析 Lagrange方程 峰值预估模型

Dynamic modeling of 3-DOF parallel mechanical leg and peak prediction of servo motor

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Abstract: A 3-DOF mechanical leg with compact structure, strong carrying capacity and the rotational motion in decoupled was proposed. To analyze the drive parameters of the 3-DOF parallel mechanical leg, a dynamic model was established and the peak of a servo motor was predicted based on the dynamic model. Firstly, by analyzing the motion parameters of the leg mechanism, the dynamic model was established based on the Lagrange equation, and the drive force acted on the mechanism was given. Then, based on the dynamic model, a peak prediction model of the servo motor for the drive speed and torque was defined. Finally, for a given motion equation and a set of structural parameters, the time curves of drive speed and torque were obtained, the dynamics of the mechanism was given and the peak prediction model was proved to be correct. Calculations show that the peaks of the drive speeds from three driving motors are 19, 17, 27 r/s for N_x , N_y and N_w ,and the peaks of the drive torque are 5.8, 3.1, 4.4 N・m for ε_x, ε_y and ε_w respectively.

Keywords: parallel mechanical leg servo motor dynamic analysis Lagrange equation peak prediction model

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