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月壤力学参数反求及试验验证

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Mechanical parameters reverse estimation of lunar soil and experimental verification

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摘要 为了预测月球车的牵引特性并进行牵引控制,提出了一种基于线性最小二乘法的月壤力学参数估计算法,对内聚力和内摩擦角这两个关键的月壤力学参数进行反求.针对反映车轮土壤交互作用过程中轮刺效应的力学模型进行简化,建立了内聚力和内摩擦角的求解模型.将车轮与模拟月壤交互作用试验中的测量数据输入利用该算法编制的Matlab程序中,反求出模拟月壤的内聚力和内摩擦角,反求值与模拟月壤的实测值较为接近.试验验证结果表明该算法准确有效,且具有较好的稳定性和较快的运算速度,可用于月球车进行月壤力学参数的就位估计.

关键词: 月壤 轮土交互作用 力学参数 月球车

Abstract: In order to predict and control the traction trafficability of a lunar rover, an algorithm for mechanical parameters estimation of lunar soil based on linear-least squares method was presented to estimate two key mechanical parameters, i.e., internal cohesion and internal friction angle. The improved wheel-soil interaction model for lugged rigid wheel which considering the effect of wheel lugs on stress distribution was simplified; An algorithm was thus created to calculate internal cohesion and internal friction angle of the soil. Experimental data of wheel-soil interaction were imported into Matlab programs to estimate cohesion and internal friction angle of lunar soil simulant, and the estimated values are close to the measured values of lunar soil stimulant. The results of experimental verification indicate that the algorithm is accurate and effective, moreover, the algorithm also shows good stability and high arithmetic speed, which allows a lunar rover to estimate mechanical parameters of the lunar soil on site.

Keywords: lunar soil wheel-soil interaction mechanical parameter lunar rover

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