

惯性稳定平台自适应前馈控制

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Adaptive feed-forward control for inertially stabilized platform

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摘要 图/表 参考文献 相关文章 (15)

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摘要 结合反馈控制提出了一种自适应前馈控制方法来提高惯性稳定平台稳定控制的指令跟踪性能。应用子空间辨识算法,由输入输出数据辨识稳定平台动态模型的状态空间描述;采用频域回路成型方法设计反馈回路控制器,用于抑制外部扰动。应用递推最小二乘(RLS)自适应滤波器构建反馈控制回路逆模型,构造指令信号的全通特性,提高指令跟踪能力。针对不同的指令信号进行跟踪实验,验证了自适应前馈控制方法的有效性。实验结果表明:提出的自适应前馈方法对阶跃指令响应快,超调量可由反馈控制的30%降低至4.5%,对30 Hz正弦信号的响应幅值无衰减,相位滞后由反馈控制的90°降低至54°。得到的结果显著提高了系统的暂态性能,控制性能优于单独的反馈控制回路。

关键词 : 惯性稳定平台, 自适应控制, 前馈控制, 自适应滤波, 子空间辨识

Abstract : An adaptive feed-forward control method combining with feedback control was proposed to improve the command tracking performance of control circuit in an inertially stabilized platform. On the basis of subspace system identification, the input-output data were used to identify a state space of the stabilized platform model and the frequency-domain loop shaping technique was used to design the feedback loop controller to reject the external disturbance. Furthermore, a Recursive Least Square (RLS) adaptive filter was taken to build the inverse model of the feedback control loop and to construct the all-pass transfer function for increasing tracking performance. Several tracking experiments were conducted on different command inputs to verify the validity of the adaptive feed-forward controller. Experimental results show that this method responds quickly to step commands and the overshoot has decreased from 30% to 4.5% as compared with that of the feedback control. For a sinusoidal signal at the frequency of 30 Hz, the adaptive feed-forward controller can obtain an amplitude response without attenuation and the phase lag is reduced to 54° from 90° as compared with that of the feedback control. This method significantly improves the transient performance and is superior to the feedback control alone.

Key words : inertially stabilized platform adaptive control feed-forward control adaptive filter subspace identification

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