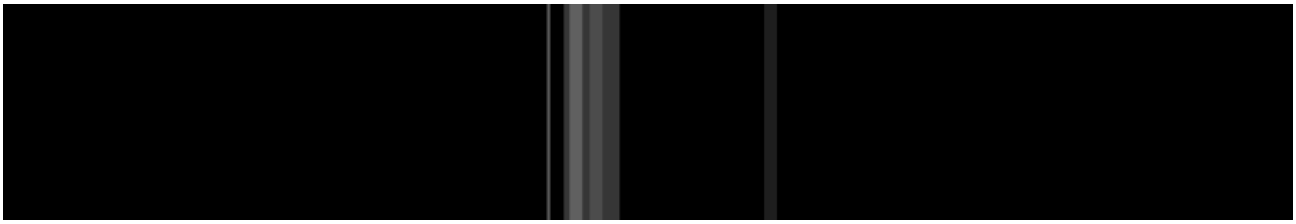

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线性扩张状态观测器及其高阶形式的性能分析

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Performance analysis on linear extended state observer and its extension case with higher extended order

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摘要 图/表 参考文献(16) 相关文章 (15)

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摘要

扩张状态观测器(ESO) 作为自抗扰控制(ADRC) 的核心组件, 其自身及高阶扩展形式的性能分析与评估至关重要. 借助Lyapunov 逆定理证明了任意扩张阶数下线性扩张状态观测器(LESO) 重构状态误差的收敛性, 并得出了观测误差上界与扩张阶数的定量关系式; 在分别考虑扩张阶数、观测器带宽以及剪切频率的情况下, 探讨了高阶及传统LESO 的动态响应、干扰抑制能力与观测器参数间的关系; 最后, 结合改进的ADRC控制器, 在估计能力、峰值现象的抑制、滤噪性能等方面对高阶及传统LESO 进行了性能评估与仿真验证. 所得出的结论可为ADRC应用中ESO的选取提供有效的理论依据.

关键词 : 扩张状态观测器, 高阶线性扩张状态观测器, 滤噪性能, 峰值现象, 扩张阶数

Abstract :

As the central component of active disturbance rejection control(ADRC), the performance analysis and evaluation on the linear extended state observer(LESO) and its extension case with higher extended order are of greatly significance. The convergence of the estimation error for LESO with any extended order is proved by utilizing Lyapunov's inverse theory. Simultaneously, the quantitative relationship between the upper bound of the estimated error and the extended order is derived. Under the consideration of the given extended order, bandwidth and the shear frequency, the relationships between parameters of the observer and the dynamic response, and disturbance attenuation ability are both analyzed. Finally, combined with enhanced controller of ADRC, the performance evaluation and simulation verification on LESO and its extension case are carried out and discussed with respect to the capability in estimation, the suppression of peaking phenomenon and noise attenuation. The obtained conclusion can provide a theoretical basis for the selection of ESO in the application of ADRC.

Key words : extended state observer(ESO) LESO with higher extended order performance of noise attenuation peaking phenomenon extended order

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