控制科学与工程

基于自抗扰控制技术的船舶直线航迹控制器设计

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摘要：

船舶直线航迹控制系统是一种单输入双输出系统,具有强非线性和典型的欠驱动特性;船舶运动又易受风、浪、流等干扰,使得航迹控制器的设计非常困难。本文给出了船舶直线航迹控制系统数学模型并对自抗扰控制技术(active disturbance rejection control technique, ADRC)进行了简要介绍。在原自抗扰算法的基础上,通过增加一个跟踪微分器以及控制律由两个被控量的误差组合而成的方法,突破了原有的自抗扰控制算法只适用于单输入单输出系统的限制,实现了船舶航向和横偏位移的良好控制。仿真结果证实了这种方法的有效性,不仅可以获得很好的系统动态性能和稳态性能,而且具有很强的鲁棒性。

关键词： 船舶　直线航迹控制　自抗扰控制　非线性控制　欠驱动系统

Straight-line tracking control of ships based on ADRC

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Abstract:

A ship's straight-line tracking control system is a single-input and dual-output system. Due to the strong non-linearity and typical under-actuated properties, as well as the liability to wind, wave and current disturbance, the design of a ship's tracking controller is challenging work. In this paper, the mathematical model of a ship's straight-line tracking control system was adopted and the ADRC(active disturbance rejection control technique)was also briefly introduced. The control scheme was accomplished by adding a tracking differentiator and the feedback control law comprised of the errors of the two-controlled variables, instead of only one in the usual ADRC scheme. Compared to the usual ADRC calculation which is only suitable for single-input and single-output systems, this method expands the application range that the ADRC scheme can deal with. The simulation test results confirmed the validity of this method, showed the ADRC can acquire good dynamic performance,good steady performance, and excellent robust performance.

Keywords: ship　straight-line tracking control　ADRC　nonlinear control;underactuated system

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