ADAPTIVE ROBUST NONLINEAR SHIP COURSE CONTROL BASED ON BACKSTEPPING AND NUSSBAUM GAIN

JIALU DU, CHEN GUO AND SHUANGHE YU
School of Automation and Electrical Engineering
Dalian Maritime University
Dalian 116026, P.R. China

e-mail: dujl@newmail.dlmu.edu.cn, guoc@dlmu.edu.cn, shuanghe@newmail.dlmu.edu.cn

ABSTRACT—Ship steering design presents challenges because the dynamic properties of the vessel itself vary significantly. This paper develops an adaptive robust nonlinear course controller for ship steering with unknown parameters, especially completely unknown control coefficient, and under unknown bounded environmental disturbances induced by waves, wind, and ocean currents. Based on the incorporation of the Nussbaum-type gain into backstepping algorithm and some technical lemmas, the proposed design method does not require any priori knowledge of the sign of the unknown control coefficient. It is proved that the designed adaptive robust controller can guarantee the uniform ultimate boundedness of all signals in the resulting closed-loop system. The control performance can be guaranteed by an appropriate choice of the design parameters. Simulation results on a 45-meter long ship are presented to validate the proposed controller.

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