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ADAPTIVE UKF BASED TRACKING CONTROL FOR UNMANNED TRIMARAN VEHICLES

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Abstract. *Trimaran which is constructed by a main centre hull and two small outer hulls has clear advantages over the normal single-hull surface vehicle. Main difficulty in the control design of Unmanned Trimaran Vehicles(UTV) is how to reject the hydrodynamic uncertainty and environmental disturbances. In this paper, a control scheme involving online parameter/disturbance estimation is proposed in order to reject the hydrodynamic uncertainty and environmental disturbances. Within the control structure, a novel adaptive Unscented Kalman Filter (AUKF) is constructed based on the master-slave structure. This intends to release the dependence of normal UKF on the priori knowledge of noise distribution, which is difficult to obtain in real systems. An AUKF-enhanced exponential tracking controller is further developed to realize the robustness with respect to the time-varying parameters and disturbances. Simulations conducted on the dynamics of a home-developed UTV test-bed demonstrate the performance of both the AUKF and the controller.*

Keywords: Unmanned trimaran vehicles (UTV), Online parameter/disturbance estimation, A novel adaptive Unscented Kalman Filter (AUKF), Exponential tracking controller

1. **Introduction.** Due to the characteristics such as pilotless, low cost, high maneuverability, long endurance, etc., and due to the potential applications in coast defense, guard, search and rescue in near future, unmanned surface vehicle (USV) is becoming a new focus in the researches of autonomous mobile vehicles. However, while a USV meeting bad sea conditions the poor stability and navigation performance are the most critical problems that limit its application in real cases. To handle this problem, two techniques may need to be further developed: one is the body shape of the USV, and another is online estimation and control to reject the uncertain disturbances due to the wind and water flow. Trimaran is constructed by a main centre hull and two small outer hulls. The two assistant hulls increase the deck surface and therefore improve the stability in overcoming the wave, while the narrow and thin shape does not introduce significant water drag so