智慧載具海氣象觀測系統開發之研究
Development of a Marine Meteorological Observation System using Smart Unmanned Vehicles

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摘　要

隨著海洋觀測技術快速發展，智慧無人載具結合自動駕駛與自動化海氣象資料蒐集技術，能在極端或危險海況條件下進行海氣象觀測任務，可有效增加海洋監測能力，並更豐富的海上資料能提升海氣象預報能力並進一步減少災害損失。本研究旨在開發一套智慧載具海氣象觀測系統，並透過測試驗證其穩定性與準確性，本研究選用智慧船智馭號作為測試平台。本研究開發之資料擷取與分析系統於實驗室測試顯示系統運作穩定，並安裝於測試平台上，並完成三趟港內航行資料接收率達100%，驗證儀器與控制系統正常。本研究進一步進行外海航行測試，船上觀測結果與鄰近浮標資料進行比對驗證，結果顯示多數風、波、水溫和海流等參數變化趨勢相當一致。其中波高、風速與表層水溫等與浮標觀測的相關性達9成以上，波浪週期和表層流速比對之均方根誤差約為0.6秒、0.11 m/s，需進一步探討改善。初步驗證證明系統能穩定蒐集海氣象資料且具可行性，但仍需累積更多觀測資料進行驗證以確保觀測系統之可靠性。

關鍵字：智慧載具、海氣象觀測、RAOs

Abstract

With the advancement of ocean observation technologies, smart unmanned vehicles equipped with autonomous navigation and automated marine meteorological data collection capabilities can perform observation tasks under extreme or hazardous sea conditions. These systems significantly enhance ocean monitoring capacity and provide richer datasets that can improve weather and wave forecasting and reduce disaster-related losses. This study aims to develop a marine meteorological observation system mounted on a smart vehicle and verify its stability and accuracy through systematic testing, using the THETIS Smart Vessel as the testing platform. The data acquisition and analysis system developed in this study demonstrated stable performance during laboratory testing and was subsequently installed on the vessel. Three harbor trial voyages were completed, achieving a 100% data reception rate and confirming the proper operation of the instruments and control systems. Offshore trials were then conducted, and observational data collected onboard were compared with those from nearby buoys. The results showed consistent trends across most parameters, including wind, waves, water temperature, and ocean currents. Correlations for wave height, wind speed, and surface water temperature exceeded 90%. However, root mean square errors for wave period and surface current speed were approximately 0.6 seconds and 0.11 m/s, respectively, indicating areas for further improvement. Preliminary verification confirms that the system is capable of stable and feasible marine meteorological data collection, though additional data and validations are necessary to ensure the long-term reliability of the observation system.

Key words : Smart Unmanned Vehicles, Marine Meteorological Observation, RAOs