VIETNAM NATIONAL UNIVERSITY
HO CHI MINH CITY
UNIVERSITY OF TECHNOLOGY

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DISSERTATION INFORMATION

Title:	Study and design of the control and guidance system for Hybrid Autonomous Underwater Vehicle (Hybrid AUV) under the influence of ocean currents and input constraints using Lyapunov's direct method
Major:	Control Engineering and Automation
Major code:	9520216
Ph.D. Candidate:	Pham Nguyen Nhut Thanh
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MAIN CONTENTS AND CONTRIBUTIONS OF THIS DISSERTATION

With the rapid development of the world and population explosion, terrestrial resources are gradually depleted, so undersea resources are the focus for humans to search and exploit. Therefore, autonomous vehicles serving the process of underwater search and exploitation are receiving significant attention. Among them, autonomous underwater vehicles (AUVs) are one of the most popular tools due to many outstanding advantages. Thus, the guidance and control algorithms for this class of objects are being widely researched to improve performance and safety during operation. However, controlling the AUV has always been a challenge since it is a 6-DOF highly nonlinear object moving in three-dimensional space with model parameters that are difficult to determine accurately, often has fewer actuators than the degrees of freedom to be controlled, and operates in an environment filled with many uncertain factors such as the ocean. This dissertation focuses on researching advanced algorithms for the class of underactuated AUVs, taking into account many physical constraints and the impact of ocean currents to improve control quality to serve complex underwater tasks. Specifically, the main contributions of the dissertation can be summarized as follows

- Research and apply prescribed performance control methodology for the depth tracking control problem and the horizontal path-following control problem of AUV under the influence of ocean currents. Simulation results show that thanks to the feature that presets the boundary on transient

response and steady-state error, the proposed algorithm has improved control performance and safety compared to other existing methods.

- Develop an integral barrier Lyapunov function and adaptive fuzzy/neural control algorithm to solve control problems considering constraints on the state and control signals of the AUV. The obtained results show that the proposed algorithm ensures that the constraints on the vehicle are always satisfied and all signals of the closed-loop system are uniformly ultimately bounded.
- To meet complex tasks in the future, the author also proposes two formation control algorithms based on a decentralized approach and a distributed approach to control multiple AUVs. Compared to existing studies, the proposed algorithms are more general when taking into account many factors, such as uncertain model parameters, constraints on the vehicle, ocean currents, and external disturbances. The simulation results show the effectiveness of the proposed algorithm in regulating a group of AUVs to realize and maintain the desired formation structure.

The practical applications of the dissertation can be mentioned as:

- The proposed depth tracking control algorithms can be applied to survey pipelines, seabed structures or support resource exploitation, salvage, and rescue,...
- The horizontal path-following control and 3-D trajectory tracking control algorithms can be applied to environmental sampling, surveillance, topographic survey, mapping,...
- The designed formation control algorithms can be applied to establish sensor networks to build seabed maps, search for and exploit marine resources,...or for military purposes such as patrolling territorial waters, searching for dangers at sea, and coordinating operations with humans,...

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