SUMMARY OF DOCTORAL THESIS

Thesis title: **Reseach on adaptive control for autonomous underwater vehicle**

Major: Marine science

Sector code: 9840106

PhD candidate: Pham Viet Anh

Formation course: 2016

Supervisions: 1. Assoc Prof.Dr. Nguyen Phung Hung

                                            2. Dr. Le Van Ty

Training institution: Ho Chi Minh City University of Transport

1. Thesis summary

Nowadays Artificial Neural Network (ANN) has been widely applied to many fields including automatic control, because ANN has ability to solve many complicated control problems, even highly nonlinear control plants with hardly unpredictable external items that make the plants hard to control. Furthermore, quickly proccesing ability of ANN also make it feasible for the ANN to control application in real time.

In Vietnam, study on advanced control systems for AUV has been new and not very widely applicated.

However, the demand for application of AUV to exploring sea, underwater constructions, inspection and maintenance of underwater pipes or cables, subsea search and rescue…are more and more. Studies on improving quality of AUV control systems, mastering manufacture technology and operation of AUV are quite necessary for the fields of exploiting, exploring, managing the sea as well as serving country defending, protecting sea, islands and the national sea sovereignty.

Based on studying on conventional and advanced AUV control methods, studying on ANN control algorithms, this thesis has developed applications of adaptive neural controller for AUV heading and depth. Using those applications AUV controller quality has been improved, new and applicable controller has been proposed.

Theory and simulated results have successfully carried out proved the deasibility of the proposed algorithms.

2. The necessity of the thesis

Vietnam has strength of sea and has planned to develop sea transport and ship building, managing and exploring sea resourses for globally integrating and meeting social demands at the target of "sea economy developing suitable for Vietnam Sea Stretagy to 2030, meeting the demand of economic – social development; contributing to national defence, security and protecting national sovereignty on Vietnamese seas and islands".

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Thus, studying on AUV control is one of the most important topics of modernizing the manufacturing and controlling AUV in Vietnam. For the above reasons, the author has selected the research on ***"Reseach on adaptive control for autonomous underwater vehicle".***

3. Objectives of the thesis

Based on studying on conventional and advanced AUV control methods, studying on ANN control algorithms, this thesis has developed applications of adaptive neural controller for AUV heading, depth and speed. Using those applications AUV controller quality is improved, new and applicable controller will be proposed. The proposed controller will be simulated and analysed.

4. Study object and extent

Studying on neural control algorithms and adaptive control based on ANN.

Proposing applications of ANN to designing adaptive neural network controller for AUV heading, depth and speed.

Using Matlab for simulating the proposed controller. Accessing adaptive neural controller in the applications of AUV control.

5. Study methods

Analysing, synthesing AUV control systems based on adaptive neural network.

Studying on applications of ANN to designing adaptive neural network controller for AUV heading, depth and speed.

Using Matlab for simulating and verifying the feasibility and accuracy of the algorithms.

Comparison method: Comparing ANN controller to conventional PID controller to prove the effectiveness of the ANN one.

6. Scientific and practical meanings

The results of the thesis can contribute to theory, reference resourses for students, researchers and PhD candidates who are interested in control field. The proposed control algorithms and study results can be applicated to designing good controllers for AUV control in practice and contributed to the development of national sea economy. These are scientific and practical meanings of the thesis.

7. New achievements of the thesis

There are new achievements of the thesis for studying theory and application of the AUV control as followings:

- Systemating theory and practice of AUV control in the world and Vietnam;
- Proposing adaptive neural controller for AUV movements' situations using online adaptive ANN.
- Verifying the proposed algorithms and applicating to AUV control in many situations using computer simulations.
- Proposing navigation and guidance control system for AUV using ANN controller, enhancing adaptive ability of the controller in the manner of improving target function and neural network's training function.

8. Conclusion

The thesis consists of the following main chapters:

- **Overview**
- **Chapter 1:** Overview of AUV (Autonomous Underwater Vehicle) control.
- **Chapter 2:** Theory of neural adaptive control for AUV.

- **Chapter 3:** Designing adaptive control system using artificial neural network fo AUV.

- **Chapter 4:** Simulation for AUV control using adaptive neural networks.

- **Conclutions**

Ho Chi Minh city, March 27th, 2022

Science supervisors   **PhD candidate**

Assoc Prof.Dr. **Nguyen Phung Hung**   **Dr. Le Van Ty**   **Pham Viet Anh**