DISSERTATION INFORMATION

Title:: **“Swimming Gait Control Of Elongated Undulating Fins Based On The Central Pattern Generator”**

Major: Mechanical Engineering Major code: 62520103

PhD candidate: Nguyen Van Dong

Supervisors: Assoc. Prof. Dr. Nguyen Tan Tien

University: Ho Chi Minh University of Technology (HCMUT), Vietnam National University Ho Chi Minh City (VNU-HCM)

SUMMARY

One of the inevitable consequences of modern warfare is the remnants of explosives left everywhere and the lasting impacts on ppeople'squality of life. For fishermen in the coastal areas of Vietnam, there is always a potential risk from mines still lying in the seabed with a lot of moss and mud. Therefore, using clones to carry out detection and destruction tasks is not only labor-intensive but also involves a lot of risks. In recent years, many Vietnamese Navy units have noticed the above inadequacy and have used underwater robots to carry out mine clearance survey work. However, a new inadequacy arises from the characteristics of the environment where the mines are located, which is often a mossy environment with a lot of ocean garbage. The robots using propellers are all stuck and not working effectively, so a solution is needed. Answers to these problems. The goal of the thesis is to help solve the above urgent problem by studying the best way to set some parameters of the propulsion system for an underwater robot using the swimming mechanism of the Gymnotiform fish class, analyzing, selecting, and building the motor controller structure for the propulsion system for the underwater robot, modeled after the construction of the South American black knifefish through the central pattern generator (CPG) motor mechanism. The thesis proceeds to use modern optimization algorithms to select the parameters of the CPG motor controller specifically: Through the reinforcement learning algorithm, determine the K coefficient characteristic for the speed. Then, change the stroke to ensure the shortest time to change the swimming shape while meeting the

output error compared to the desired stroke is minimal. In addition, to ensure the swimming frequency is consistent without causing fluctuations in the underwater sound frequency to avoid detonating the non-contact fuse of the torpedo (sonar turbulence), but still, ensure the maximum thrust to get the robot out of dangerous areas instantly regardless of the energy consumption factor. The thesis proposes to apply the swarm optimization algorithm to find the set of amplitude parameters A1, …, and A16 for maximum thrust at the same frequency. After running the thrust simulation 4251 times, the maximum thrust of the module is 3.60N was found.

The results of the thesis can be applied to optimize the sets of CPG parameters for the longitudinal propulsion modules corresponding to each frequency level with the ability to switch flexible swimming postures and achieve the best thrust corresponding to the mechanical characteristics. Push modules that simulate the median and paired fin (MPF) swimming mechanism, thereby serving as the basis for developing higher-layer control algorithms for fish robots using this modular propulsion system.

Supervisors	**PhD candidate**
Assoc. Prof. Dr. Nguyen Tan Tien	**Nguyen Van Dong**