BM13.2-ĐT-BVCS

MINISTRY OF EDUCATION AND TRAINING
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY AND ENGINEERING

THE SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom - Happiness

SUMMARY OF CONTRIBUTIONS OF THE DISSERTATION

PhD candidate : Duc-Dat Ngo Fellows code: 2027001
Major : Electronics Engineering Major code: 62520203
Dissertation title : Identifying and classifying ships in coastal surveillance using artificial intelligence.
Supervisor one : Asos. Prof. My-Ha Le
Supervisor two : Asos. Prof. Manh-Hung Nguyen

Summary of theoretical and academic contribution of the dissertation:

The thesis proposes deep learning models for maritime vessel detection based on camera and pulse radar sensors. The proposed models are evaluated using both published image datasets and a real-world pulse radar dataset that was collected from coastal surveillance stations in Vietnam.

In camera based detection, two deep-learning-based models have been investigated for ship detection. The first model is built upon a convolutional neural network (CNN) architectures. The baseline model (YoloX) is customized by incorporating feature selection modules. These feature selection modules are designed to extract compressed features that are suitable for vessel detection while suppressing redundant and irrelevant information. Therefore, it could learn discriminative feature representations for a task. Experimental results on large-scale datasets demonstrate that the proposed model achieves higher detection accuracy with significantly fewer training samples. Moreover, the performance gain becomes more pronounced as the number of training samples decreases. Feature maps indicate that the proposed model exhibits more focused and discriminative activation patterns than conventional CNN-based approaches.

The second image-based model is a transformer-based object detector. Transformer-based models inherently employ attention mechanisms that emphasize salient regions of the input. The attention is similar to feature selection strategies in terms of identifying important features. As a result, the model achieves high detection accuracy. The improvement is more pronounced in scenarios with limited training data. The attention maps produced by this model are superior to the feature selection modules embedded in CNN architectures.

Not only focusing on the camera, the thesis also investigates radar signals. This dissertation utilizes data collected from a pulse radar station in Vietnam. Domain knowledge from maritime surveillance experts is incorporated to guide the deep learning model in extracting physically meaningful and task-relevant features. Subsequently, a vessel classification approach based on pulse radar signals is presented. Here, the