

VESSELS CLASSIFICATION

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ABSTRACT

Moment based invariants, in various forms, have been widely used over the years as features for recognition in many areas of image analysis. The proposed work will look at offline ship recognition using ships silhouette images which will include recognition of part of an object for situations in which only part of the object is visible. The model-based classification is design using Image Processing MATLAB Toolbox. The moment invariant techniques apply for features extraction to obtain moment signatures to do classification. The minimum mean distance classifier is used to classify the ships which works based on the minimum distance feature vector. This research study will address some other issue of classification and various conditions of images that might exist in real environment.

ABSTRAK

Momen yang tidak berbeza, dalam berbagai-bagai bentuk, telah banyak digunakan bertahun-tahun dahulu sebagai ciri-ciri untuk proses pengecaman dalam pelbagai bidang analisis imej. Cadangan projek ini akan melihat pada pengecaman kapal menggunakan imej bayang-bayang secara luar talian dan tumpuan diberikan kepada paparan sebahagian objek dalam situasi hanya sebahagian objek sahaja yang kelihatan. Klasifikasi berasaskan model ini direkabentuk dengan menggunakan perisian MATLAB. Teknik momen yang tidak berbeza digunakan untuk ciri-ciri pemisah bagi mendapatkan momen pengenalan bagi tujuan klasifikasi. Teknik klasifikasi yang digunakan untuk mengklasifikasi kapal ini menggunakan jarak purata minima bagi tiap-tiap vektor pencerian. Projek ini juga turut mengetengahkan isu-isu lain dalam proses klasifikasi dan pelbagai imej dalam situasi yang mungkin wujud dalam persekitaran sebenar.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
1	INTRODUCTION	1
	1.0 PROBLEM STATEMENT	1
	1.1 PROJECT GOALS	2
	1.2 OBJECTIVES OF THE PROJECT	3
	1.3 SCOPE OF PROJECT	3
	1.4 PROJECT OUTLINE	4
2	LITERATURE REVIEW	5
	2.0 OVERVIEW	5
	2.1 MORPHOLOGY	8
	2.2 SHAPE DESCRIPTOR	8
	2.2.1 MOMENT	9
	2.2.1.1 STATISTICAL MOMENT	9
	2.2.1.2 MOMENT OF TWO DIMENSIONAL FUNCTIONS	11
	2.2.1.3 RESPONDS TO TRANSFORMATION	12
	2.2.1.4 MOMENT INVARIANT	13
	2.3 FEATURE VECTOR	15
	2.4 CLASSIFICATION RULES	15

3	RESEARCH METHODOLOGY	17
3.1	DESIGN	17
3.1.1	GENERAL MOMENT INVARIANT ALGORITHM	18
3.2	LIBRARY CREATION	18
3.3	TESTING AND IMPLEMENTATION	25
4	RESULTS & DISCUSSION	29
4.1	EXPERIMENT	29
4.2	RESULT	30
4.3	SENSITIVITY ANALYSIS	35
4.4	DISCUSSION	41
4.4.1	PROCESSING TIME	42
4.4.2	DRAWBACK	42
5	CONCLUSIONS	43
5.1	CONCLUSIONS	43
5.2	RECOMMENDATION FOR FURTHER RESEARCH	44
	REFERENCES	45
	APPENDICES	47-66

LIST OF TABLES

TABLE NO.	TITLE	PAGE
3.1	Warship Recognition Features	21
4.1	Partial view for Merchant Type	30
4.2	Full Outline Combatant Type Identification	31
4.3	Partial view for Combatant Type	32
4.4	Full Outline for combinations of Merchant and Combatant Type	33
4.5	Partial view for combinations of Merchant and Combatant Type	34
4.6	Scaling, Translation and Rotation effects for Full Outline	36
4.7	Scaling, Translation and Rotation effects for Frigates or Destroyers	37
4.8	Scaling, Translation and Rotation effects for Corvettes	37
4.9	Scaling, Translation and Rotation effects for Patrol Forces	38
4.10	Scaling, Translation and Rotation effects for Mine Warfare Forces	39
4.11	Scaling, Translation and Rotation effects for Aircraft Carriers	39
4.12	Partial view for noisy image	40

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Left to Right: clipped, overlapped with another silhouette	2
3.1	Vessels type category	19
3.2	Probability density of length distribution	20
3.3	Library Creation Flow Chart	24
3.4	Line Scan Transform	25
3.5	Ratio Computation	26
3.6	Ship Length-to-Height Ratio	27
3.7	Testing and Implementation Flow Chart	28
4.1	Sensitivity Analysis apply on scale change, translation and rotation	35
4.2	Speckle noise	40
4.3	Percentage of correct classification for partial object	41

LIST OF SYMBOLS

μ	Mean
μ_x	Mean pixels values of x-coordinates
μ_y	Mean pixels values of y-coordinates
μ_n	n-th Central Moment
\bar{x}, \bar{y}	Centroid of image
σ^2	Variance
η_{pq}	Normalized Central Moment
γ	Normalisation factor
ϕ_n	n-th Moment Invariant
$d(X, i)$	Weighted distance
C	Covariance matrix

LIST OF ABBREVIATIONS

ROI	Region of Interest
FLIR	Forward Looking InfraRed

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	MATLAB Codes for Merchant (Full Image)	47
B	MATLAB Code for Combatant (Partial Image)	55
C	Graphical User Interface (GUI) for Merchant Type	65
D	Graphical User Interface (GUI) for Combatant Type	66

CHAPTER 1

INTRODUCTION

Automatic object recognition has diverse applications in various fields of science and technology and is permeating many aspects of military and civilian industries. Autonomous recognition of ships can provide better tracking and automatic monitoring to control from potential enemy ships.

Recent advanced in imaging technology improves its ability to see ships at night and observed ships from any angle. Then, the classification is done to confirm its identity in the case of country of origin and vessels type. So, this project addresses model-based classification of warship of different categories with acceptable accuracy.

1.0 PROBLEM STATEMENT

Automatic ship recognition is an interesting research area in military industry. In current practice, a person is employed to watch the water area constantly to monitor and recognize the type of vessels. This process is very daunting for human to do. In present situation, a monitoring of the coastal area and recognizing the type of vessels that enter the coastline is very important in security. Thus, the use of image processing algorithms that could detect and identify incoming vessels is very useful for automatic system.



Figure 1.1: Left to right: clipped, overlapped with another silhouette

Figure 1.1 shows that classification of objects based on silhouettes is easily affected by scale changes, clipping and occlusions with another silhouettes. Moments based approach use to represent subregion of an object for situations in which only part of object is visible.

1.1 PROJECT GOALS

The main approach is model-based, where the types of warship to be recognized are known in advanced and can be categorized into different classes. Each class is defined by the structures it contains and their arrangement on the deck. The specific library divided into two categories which are Merchant (recorded image) and Combatant type. The specific model database contains 6 classes of ships: destroyer, frigate, aircraft carrier, patrol forces, mine warfare forces and merchant ship.

For each ship silhouette, feature vector will be extracted and calculate moment signatures. Then for testing purpose, compute the signatures for a ship image of unknown type. The unknown type could be change in positions, rotated in certain angle or scaled. Classification is done using the minimum mean distance classification by finding the minimum distance among all pattern vectors. This is done through the representation of means and variance of each class.

1.2 OBJECTIVES OF THE PROJECT

The objectives of this project are:

- a. To design, develop and produce technique for the classification of vessels
- b. To select features that adequately and uniquely describe the vessels to be identified

1.3 SCOPE OF PROJECT

Many researches have been done in this area using Forward Looking InfraRed (FLIR) images, radar images, simulated images and visual-light images. In this project, the sample data set are the offline ships images which is not applicable for real-time applications.

The design coding will be implemented based on MATLAB 7.0 software using the Image Processing Toolbox. Then, this project need some pre-processing before the objects can be detected to obtain the silhouette images sample data set.

There are some limitations in this project, where the data collections are horizontal view images and the distance of object is unknown. Thus, the proposed algorithm is not intended for satellite or aerial view images.

1.4 PROJECT OUTLINE

The Project is organized into five chapters. The outline is as follows:

- **Chapter 1 Introduction**

This chapter discusses the objectives and scope of the project and introduces some background with respect to the problem to be solved.

- **Chapter 2 Literature Review**

This chapter is about previous work regarding to the pattern recognition especially to the vessels classification for military purposes. Moment techniques approach will be explained in details and the chronology of moments invariants apply for pattern recognitions. This chapter also subsumes the classification techniques apply for vessels classifications.

- **Chapter 3 Design Methodology**

Chapter 3 elaborates the techniques and steps taken to complete the task. The important part is the development phase that explained in detail how to classify imperfect Region of Interest (ROI).

- **Chapter 4 Results and Discussion**

The results will evaluate all experiments that have been done and discuss the performance of the proposed techniques. Sensitivity analysis of the results is also included.

- **Chapter 5 Conclusion**

This chapter consists of conclusion for this work. It also describe the problems arises and recommendations for future research.