A Fuzzy Mathematical Model to Motion Detection with Monocular Vision

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Declaration

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Contents

		Page
Chapter 1 Introduction		**1**
1.1	Prolegomena	1
1.2	Background and Motivation	1
1.3	The Research Objectives	2
1.4	The Postulated Solution and How We Implemented It	2
1.5	Outline of the Dissertation	5
1.6	Summary	5
Chapter 2 Recent Trends in Obstacle Avoidance with Monocular Vision		**7**
2.1	Introduction	7
2.2	Monocular Vision based object recognition - how it is done	7
2.3	Attempts of use of Fuzzy For Vision Aided Decision Making	20
2.4	Summary	22
Chapter 3 Fuzzy-Mathematical Modeling: A Novel Approach		**21**
3.1	Introduction	23
3.2	The Hypothesis	23
3.3	Technology Adapted	23
3.3.1	Users	23
3.3.2	Inputs	23
3.3.3	Outputs	23
3.3.4	Process	24
3.4	A Comprehensive Study on Desired Solution	24
3.5	The Problem Re-Defined	27
3.6	Why Not Mathematical Modeling? In-Detailed Discussion	27
3.7	Summary	29
Chapter 4 Analysis and Design		**27**
4.1	Introduction	30
4.2	The Image Processing Module	31
4.3	Fuzzy Mathematical Model	32
4.3.1	Interesting Findings	32

4.3.2 Modeling behavior of Sk and m with fuzzy for m range -0.1 to -0.6 (Sk 1.00 - 0.00) 34
4.3.3 Another interesting finding 38
4.3.4 Note on gradients not concerned above 43
4.4 The Robot 44
4.5 The proposed strategy of avoiding an obstacle 45
4.6 Summary 46
Chapter 5 Implementation **48**
5.1 Introduction 48
5.2 Image Processing Module 48
5.2.1 Statistical Approach I 50
5.2.2 Statistical Approach II 51
5.3 Fuzzy Mathematical Model 54
5.4 The real time application 57
5.5 Hardware implementation : The mobile robot 58
5.5.1 Theory of motor control 60
5.6 Summary 60
Chapter 6 Evaluation **62**
6.1 Introduction 62
6.2 Evaluating Image Processing Module 62
6.2.1 Note on Motion Path Generator 63
6.3 Fuzzy Mathematical Model (Simulator) 65
6.4 Evaluating the Fuzzy Inference Engine , Real Time version 67
6.5 Time taken to achieve an accuracy level (Response time) 69
6.6 Summary 71
Chapter 7 Conclusion **72**
7.1 Introduction 72
7.2 Problem with real time version of the Fuzzy Inference Engine 72
7.3 Improvements required for the current model 75
7.4 Practical applications of the concept 75
7.5 Final conclusion 75
7.6 Recommendations and future developments 76

7.7 Final word and the summary 76

References 77

Appendix A: Improvements on Image Processing and Optical Flow Algorithms - Code Level Implementation **80**

A.1 Introduction 80

A.2 Structure of the Code -An Abstract View 80

A.3 Statistical Approach I 83

A.4. Statistical Approach II to Mark ROI (Region of Interest) 86

A.5 Edge Detection to Image Segmentation 87

Appendix B: Real-World Data Collected for Constructing the FMM **89**

B.1 Introduction 89

B.2 Apparent Size - Distance Variation 89

B.3 Relationship between the Skewness and Gradient (m) 90

B.4 Relationship between the *c*, Initial Apparent Size and *m* 90

B.5 Real World Data to Realize Fuzzy Membership Functions 92

B.5.1 Fuzzy Membership of *m* and *Sk* ($0 \leq SK \leq 1.0$) 92

B.5.2 Fuzzy Membership of *m* and *Sk* ($-0.01 \leq SK \leq -0.52$) 94

B.5.3 Fuzzy Membership of *m* and *Sk* ($-0.53 \leq SK \leq -3.0$) 95

B.5.4 Fuzzy Membership of *c*, *m* and Initial Apparent Size 98

Appendix C: Code Level Implementation of FMM 101

C.1 Introduction 101

C.2 Implementation of FMM-Simulator Version 101

C.3 Implementation of FMM: Real-Time Version 105

Appendix D: Evaluation Results - Full Detailed View 108

D.1 Introduction 108

D.2 Evaluation of FMM-Simulator Version 108

D.3.1 Evaluation of FMM - Real Time Version by Accuracy Reported After a Definite Time 109

D.3.2 Evaluation of FMM - Real Time Version by Time Elapsed to Achieve an Accuracy Level 109

Appendix E: Source Code of the Robot 112

E.1 Introduction 112

List of Figures

		Page
Figure 3.1:	Variation of depth expected	25
Figure 3.2a.	Expected graph for apparent size change	25
Figure 3.2b.	Actual graph for apparent size change	25
Figure 3.3:	Variation of the subtended angle created by the object.	25
Figure 3.4:	A mathematical model for relationship between depth and apparent size	26
Figure 3.5:	A generic case of object movement	27
Figure 3.6:	Equation of the curve of apparent size change	28
Figure 4.1:	System Design Overview	30
Figure 4.2 :	The defined coordinate system	33
Figure 4.3:	Hypothetical fuzzy membership function of m and sk	34
figure 4.4:	Look-up table for Sk and fuzzy membership values	35
Figure 4.5 :	Fuzzy membership function for *m*=-0.1 to -0.6	35
Figure 4.6 :	Hypothetical fuzzy membership function for minus range of Sk, up to -0.52	36
Figure 4.7 :	The look-up table that keeps y values for minus Sks	37
Figure 4.8:	Fuzzy membership function for *m*=-0.6 to -1.0	37
Figure 4.9 :	Hypothetical fuzzy membership function for gradients lesser than -1.0	38
Figure 4.10 :	Fuzzy membership function for gradients lesser than -1.0	38
Figure 4.11 :	Variation of c with m and initial size	39
Figure 4.12 :	Variation of, w.r.t. initial size change, at m=-0.1	40
Figure 4.13:	Variation of, w.r.t. initial size change, at m=-1.0	40
Figure 4.14:	Hypothetical fuzzy membership function of c Vs. initial size	41
Figure 4.15:	Fuzzy membership function of *c* with initial size	41
Figure 4.16	Finding actual c	42
Figure 4.17	Fuzzy membership function of gradient and c	42
Figure 4.18 .a :	A movement path with a negative gradient	43
Figure 4.18 .b :	A movement path with a positive gradient	43
Figure 4.19 :	A case where m<-0.1 and the obstacle first observed at a far-	44

	away distance	
Figure 4.20 :	Design of the robot	45
Figure 4.21 :	The Risk Boundary - Checking whether the motion is risk or safe	45
Figure 4.22:	Diverting the motion path of robot due to high risk factor estimated	46
Figure 5.1:	The anatomy of the IPM	48
Figure 5.2:	Classification of optical flow vectors in to belonging quadrants	50
Figure 5.3:	Before Statistical approach (I)	50
Figure 5.4:	After Statistical approach (I)	51
Figure 5.5:	Finding the 'Centre of Gravity' of optical flow vectors	51
Figure 5.6:	Results of Statistical approach (II)	52
Figure 5.7:	Recognizing the ROI	52
Figure 5.8:	Tracking multiple moving objects	53
Figure 5.9 :	Identifying the only appropriate object of movements	53
Figure 5.10 :	Final stage of image processing	54
Figure 5.11 :	The Motion Path Generator	55
Figure 5.12:	An arbitrary generated obstacle motion using Motion Path Generator	56
Figure 5.13:	Recovery of the actual motion path by the Fuzzy system when the two graphs are provided	56
Figure 5.14:	The Real Time Application	57
Figure 5.15:	The mobile robot	58
Figure 5.16:	Velocity encoders	59
Figure 5.17:	Relationships between the encoder resolution and desired angle to turn	60
Figure 6.1:	Actual apparent size Vs. detected apparent size	62
Figure 6.2:	Accuracy of Image Processing Module	63
Figure 6.3:	The measuring the actual distance	63
Figure 6.4:	Actual relationship of distance and apparent size of the object	64
Figure 6.5:	Correlation with distance and apparent size of the object	64

Figure 6.6:	Variation of error, m & c with gradients	65
Figure 6.7 :	Accuracy of estimated m and c from Fuzzy Inference Engine - Simulator version	66
Figure 6.8:	Accuracy of c varies with the actual value itself	66
Figure 6.9 :	Percentages of accuracy ranges	68
Figure 6.10:	Accuracy achievement of c alone	69
Figure 7.1:	Effect of shadows for the accuracy of Image Processing Module	72

List of Tables

		Page
Table 2.1:	Summary of some interesting research in domain of monocular vision	19
Table 4.1 :	The relationship between the skewness and the gradient, for +ve Sks	33
Table 4.2 :	The relationship between the skewness and the gradient, for -ve Sks	34
Table 4.3 :	The relationship between the skewness and the gradient, for m<-0.6	36
Table 4.4	The relationship between the skewness and the gradient, for *m*<-1.0	37
Table 6.1:	Count of accuracy achievement, c alone	68
Table 6.2:	Time taken to achieve the accuracy level, for both m and c	69
Table 6.3:	Average time consumed to achieve an accuracy level	70
Table 6.4:	Time taken to achieve the accuracy level, c alone	70
Table 6.5:	Average time consumed to achieve an accuracy level	71
Table 7.1:	Response delay (Min. reaction time) of camera	73
Table 7.2:	Frame rate processed by image processing module	74

Abstract

Vision based decision making and obstacle avoidance of a mobile robot are the most attracted areas of the domains of Computer Vision and Robotics respectively. The link between them is, Computer Vision, more specifically the vision for intelligent machines is heavily used for mobile robots as a primary sensory input to perceive the external world. Vision based obstacle avoidance is one of the major areas of study Robotics. Estimating and predicting the motion behavior of a dynamic object with a single camera, known as monocular vision, is a real challenge. We postulated this can be done by analyzing a sequence of image frames extracted from a live video stream. But, these analytical techniques must be extremely fast in real time processing, because the decisions drawn within reasonably short response time are the only factors to ensure the safety of the robot. Therefore, we postulated a fuzzy mathematical model - an artificial intelligence approach to perform that task, which has a significant impact in terms of simplicity (reduced complexity) together with efficiency (minimized computational overhead : resource consumption), rather than conventional complicated mathematical modeling. The evaluation results of the all major modules of the software artifact developed to test the hypothesis of the research, namely Image Processing Module, Fuzzy Mathematical Model exhibit the validity of the concept postulated. For example, average accuracy of the Image Processing Module and the Fuzzy Mathematical Model (Simulator version) are 89% and 92% respectively. Finally, it is proven with strong evidences that, fuzzy mathematical modeling is appropriate to recover motion even from simple inputs such as apparent size variation, while monocular vision is adequate perceive to capture those primary inputs. Therefore the ultimate milestone of the research, developing an artifact (a strategy) to test the conceptually postulated theory in both theoretical (perfect i.e. simulation environments) and practical (real world noisy environments) aspects, has been achieved successfully.