

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRAK	v
	ABSTRACT	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF APPENDICES	xiii
CHAPTER 1	INTRODUCTION	1
	1.1 Research Background	3
	1.2 Objective	4
	1.3 Scopes	4
	1.4 Problem Statement	5

CHAPTER 2	LITERATURE REVIEW	7
2.1	Detonation	7
2.2	Pulse Detonation Engine	10
2.3	Augmentor	11
2.4	Previous Study on Thrust Optimization for PDE	13
2.4.1	Thrust Optimization Using Nozzles	13
2.4.2	Thrust Optimization Using Ejectors	15
2.5	Thrust Augmentation	18
CHAPTER 3	METHODOLOGY	19
3.1	Ejector Configuration	20
3.1.1	Ejector Inlet	20
3.1.2	Ejector Exhaust Geometry	21
3.2	Experimental Setup	25
3.3	Thrust Measurement	27
CHAPTER 4	RESULTS AND DISCUSSIONS	31
4.1	PDE Performance	32
4.1.1	Improvement in Data Collection	35
4.2	PDE Without Ejector	37
4.3	Effect of Straight Ejector	40
4.4	Effect of Convergent Ejector	42
4.5	Effect of Divergent Ejector	43
4.6	Effect of Converge-Divergent Ejector	45
4.7	Effect of Ejector Geometry	46

CHAPTER 5 CONCLUSION	48
REFERENCES	50
APPENDICES	53

LIST OF TABLES

TABLE NO.	TITLE	PAGE
3.1	Basic configurations for the ejector	21

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	The Rankine-Hugoniot curve for combustion process	8
2.2	The pulse detonation engine cycle.	10
2.3	Ejector schematic	11
2.4	(i) Pulse Detonation Engine tube with various exit nozzles, (ii) the shapes of the four different exit nozzles and (iii) the 2D mesh used for the CD Nozzle case	14
2.5	Shadowgraph images of PDE –Ejector interaction. Axial position, $x/D_{PDE}=2$.	16
3.1	Inlet geometry of ejector	21
3.2	Left; ejector right; ejector inlet	22
3.3	Sketches of ejector used in experiment. From above; Convergent ejector, middle; Divergent ejector, bottom; Converge-Divergent ejector	23
3.4	From left; Diverge ejector, Converge ejector, Converge-Diverge ejector and Straight ejector	24
3.5	PDE sequences	25
3.6	Diagram of ejector geometry	26
3.7	Position of the ejector	27
3.8	Schematic diagram of the experimental setup	28
3.9	Idealized pressure history at thrust surface	29
3.10	(a) Pressure transducer; (b) 9331B load cell	30
4.1	Thrust recorded by previous researcher	32

4.2	MSD digital 6A ignition control	33
4.3	The improvements of the thrust generated by the PDE	34
4.4	Block diagrams constructed using DAQ Assistant for recording the data	35
4.5	Improved NI-DAQmx block diagrams for recording the data	36
4.6	Thrust produced by the PDE operated at frequency 5 Hz	37
4.7	Pressure profile of transducer 1 with frequency of 5 Hz	38
4.8	Baseline experiment. (a) Pressure profile recorded by pressure transducer 1. (b) Pressure profile recorded by pressure transducer 2	39
4.9	Thrust produced by the PDE operated at frequency 5Hz with straight ejector at position $x/D_{PDE}=-1$ (Upstream)	41
4.10	The effect of axial position on ejector performance for straight ejector	41
4.11	The effect of axial position on ejector performance for convergent ejector	43
4.12	The effect of axial position on ejector performance for divergent ejector	44
4.13	The effect of axial position on ejector performance for converge-divergent ejector	45
4.14	The effect of different type of ejector geometry	46

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	B NI-DAQ block diagram for simulating the signals	53
B	The propane, C ₃ H ₈ -oxygen mixtures characteristics calculated by CEA code	54
C	Lab Sheet and Check List	58