



## TABLE OF CONTENTS

APPROVAL PAGES .....	ii
PERNYATAAN BEBAS PLAGIARISASI .....	iii
PREFACE .....	iv
TABLE OF CONTENTS .....	vi
LIST OF FIGURES .....	ix
LIST OF TABLES .....	xi
INTISARI.....	xii
ABSTRACT.....	ii
CHAPTER I INTRODUCTION .....	1
1.1 Background.....	1
1.2 Research Problem .....	2
1.3 Research Limitation .....	3
1.4 Purpose of Research.....	3
1.5 Benefits of Research .....	3
1.6 Research Methodology .....	3
1.7 Systematic of Writing .....	4
CHAPTER II LITERATURE REVIEW.....	6
CHAPTER III BASIC THEORY.....	9
3.1 Quadrotor .....	9
3.1.1 Quadrotor Kinematics.....	9
3.1.2 Quadrotor Dynamics.....	14
3.1.3 Quadrotor Mathematical Model.....	18
3.2 Model Predictive Control (MPC).....	19
3.3 Linear Parameter Varying (LPV).....	22
3.4 Digital Motion Processing .....	23
3.5 Inertial Measurement Unit (IMU).....	24
3.5.1 Accelerometer Data .....	24



3.5.2 Gyroscope Data.....	25
CHAPTER IV RESEARCH METHOD .....	26
4.1 Material and Tool.....	26
4.2 Research Activities .....	27
4.3 Control System Design .....	28
4.4 Algorithm Design.....	33
4.4.1 Trajectory Design .....	37
4.4.2 Position Controller Design.....	38
4.4.3 Linear Parameter Varying Design .....	41
4.4.4 MPC Matrices Design.....	43
4.4.5 Sensor Calibration and Data Acquisition.....	45
4.4.6 Communication from Raspberry Pi and Teensy 4.1 Design .....	46
4.4.7 Controller Output Design.....	47
4.5 Hardware Design .....	49
4.6 System Requirements.....	50
4.6.1 System Requirements for Simulation .....	50
4.6.2 System Requirements for Real-World Implementation.....	51
4.7 System Testing.....	52
4.7.1 LPV-MPC Simulation.....	53
4.7.2 LPV-MPC Real-World Implementation.....	53
4.7.3 Comparison between Simulation and Real-World Data.....	53
CHAPTER V IMPLEMENTATION .....	54
5.1 Hardware Implementation .....	54
5.2 LPV-MPC Simulation Implementation .....	58
5.3 LPV-MPC Real-World Stationary Position Implementation .....	59
5.3.1 Main Program .....	60
5.3.2 Reference Trajectory Implementation .....	61
5.3.3 Position Controller.....	62



5.3.4	Linear Parameter Varying.....	63
5.3.5	MPC Simplification .....	64
5.4	Sensor Calibration and Data Acquisition Implementation .....	65
5.5	Communication Data Implementation.....	66
5.6	Controller Output Implementation.....	68
CHAPTER VI RESULTS AND DISCUSSION.....		70
6.1	Simulation.....	70
6.2	Real-World Flight Test .....	71
6.3	Attitude Performance Response.....	72
6.3.1	Roll Response .....	72
6.3.2	Pitch Response.....	75
6.3.3	Yaw Response.....	78
CHAPTER VII CONCLUSION AND RECOMMENDATION .....		82
7.1	Conclusion .....	82
7.2	Recommendation .....	82
REFERENCE.....		83