

CONTENT

| | |
|--|-------|
| APPROVAL PAGE | ii |
| ORIGINALITY STATEMENT SHEET | iii |
| ABSTRACT | iv |
| PREFACE | v |
| ACKNOWLEDGE | vi |
| CONTENT | ix |
| LIST OF FIGURES | xii |
| LIST OF TABLES | xviii |
| CHAPTER I INTRODUCTION..... | 1 |
| 1.1 Background..... | 1 |
| 1.2 Problem Formulation..... | 4 |
| 1.3 Objective | 5 |
| 1.4 Scope of Work..... | 5 |
| 1.5 Methodology | 6 |
| 1.6 Hypothesis..... | 7 |
| 1.7 Thesis Structure..... | 7 |
| CHAPTER II BASIC CONCEPT | 9 |
| 2.1 Radio Detection and Ranging..... | 9 |
| 2.2 Frequency Modulated Continuous Wave (FMCW) Radar..... | 10 |
| 2.3 Estimation of Vegetation Electric Properties Values..... | 14 |
| 2.4 Estimation of Relative Permittivity of Soil | 16 |
| 2.5 Topp Model Equation for Estimating Soil Water Content | 21 |
| 2.6 State of The Art | 22 |
| CHAPTER III RESEARCH METHODOLOGY | 27 |

| | |
|--|-----------|
| 3.1 Proposed Method..... | 27 |
| 3.2 Numerical Simulation Scenario | 28 |
| 3.3 Data Collection Experiment Scenario | 29 |
| 3.4.1 Estimation of Vegetation Electric Properties..... | 30 |
| 3.4.2 Estimation of Soil Water Content in Tea Plantation | 32 |
| 3.4 Data Processing | 34 |
| 3.4.1 Data Processing for Estimating Vegetation Electric Properties | 34 |
| 3.4.2 Data Processing for Estimating Soil Water Content in Static Condition | 35 |
| 3.4.3 Data Processing for Estimating Soil Water Content in Dynamic Condition | 36 |
| CHAPTER IV RESULTS AND ANALYSIS..... | 41 |
| 4.1 Numeric Simulation Result | 41 |
| 4.1.1 The Effect of Vegetation on The Estimation Results | 42 |
| 4.1.2 Comparison Result Between Proposed Method and Direct Conversion | 44 |
| 4.1.3 Performance of The Proposed Method on Various Noise | 45 |
| 4.2 Experimental Results in Tea Plantation..... | 47 |
| 4.2.1 The Effect of Vegetation on The Estimation Results | 47 |
| 4.2.2 The Effect of Variation in Vegetation and Soil on The Estimation Results | 51 |
| 4.2.3 Estimation of Soil Water Content by Considering the Presence of Vegetation in Static Condition..... | 53 |
| 4.2.4 Estimation of Soil Water Content by Considering the Presence of Vegetation in Dynamic Condition | 56 |
| CHAPTER V CONCLUSION | 64 |

| | |
|---|------------|
| 5. 1 Conclusion..... | 64 |
| 5. 2 Suggestion | 65 |
| REFERENCE | 66 |
| APPENDIX..... | 71 |
| A MAGNITUDE RESPONSE OF LPF OUTPUT OF THE EXPERIMENT IN STATIC CONDITION..... | 72 |
| B MAGNITUDE RESPONSE OF LPF OUTPUT OF THE EXPERIMENT IN DYNAMIC CONDITION..... | 87 |
| C LPF RESULTS | 97 |
| D T-TEST RESULTS | 107 |