

## TABLE OF CONTENTS

<b>1. INTRODUCTION .....</b>	<b>1</b>
1.1. Motivation .....	1
1.2. Outline .....	4
<b>2. RELIABLE VARIABLE STRUCTURE CONTROL OF NONLINEAR SYSTEMS .....</b>	<b>5</b>
2.1. Introduction .....	5
2.2. Reliable Stabilization Control Design via VSC Scheme .....	6
2.2.1. Problem Formulation .....	6
2.2.2. Passive Reliable Design .....	6
2.2.3. Active Reliable Design .....	10
2.3. Reliable Control of Spacecraft Attitude Tracking Problem .....	13
2.3.1. Spacecraft Dynamics Analysis .....	13
2.3.2. Fault Detection and Diagnosis (FDD) Observer Design .....	20
2.3.3. Reliable VSC Controller Design .....	23
2.3.4. Simulation Result .....	26
<b>3. MEASUREMENT OF CONTROLLABILITY .....</b>	<b>39</b>
3.1. Introduction .....	39
3.2. Defects of Classical Controllability Measurement .....	40
3.2.1. Controllability Analysis of Spacecraft .....	41
3.2.2. Energy Required to Transfer States .....	44
3.3. Distance to Uncontrollable .....	46
3.3.1. Introduction .....	46
3.3.2. Distance Measurement .....	46

3.3.3. An Algorithm to Compute the Distance .....	48
3.3.4. Spacecraft Example .....	49
3.4. Mobility of Eigenvalues .....	51
3.4.1. Introduction .....	51
3.4.2. System with Distinct Eigenvalues (Part I) .....	52
3.4.3. System with Distinct Eigenvalues (Part II) .....	53
3.4.4. System with Repeated Eigenvalues .....	57
3.4.5. Mobility of Spacecraft .....	58
APPENDIX 3A. ....	60
4. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH .....	62
 BIBLIOGRAPHY .....	64